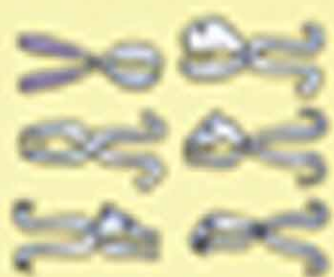


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Exodontia Practice

DropBooks Abhay N Dastarkar

Foreword
RS Dolas

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Exodontia Practice

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RS Dolas

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Exodontia Practice

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Chapter

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Introduction

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Exodontia Practice

Oral and maxillofacial surgery is a medical specialty concerned with diagnosis and treatment of diseases of jaws, teeth, mouth and face.

Exodontia can be defined as painless removal of a tooth or tooth root from its socket with minimal injury to the bone and surrounding structure so that postoperative healing is uneventful.

Dentistry is one of the fastest growing science of medicine. With the introduction of many newer instruments and anesthesia, extraction is a routinely carried out procedure in dental office. Tooth extraction remains an essential component of both the art and science of dentistry despite the enormous progress in the prevention of dental disease made during the last three decades of the twentieth century. The effect of the fluoride revolution and increasing public awareness of oral health means that people in the western world are retaining their teeth longer and fewer teeth are being extracted, particularly in adolescents and young adults. This trend towards the retention of the natural dentition into later life is resulting in more extractions being needed in older patients, who have more complicated medical history and bone is more brittle than the young. Thus, the difficulty and complexity of extraction procedures is increasing with the average age of our patients.

Dental surgeons, especially those in practice, are required to face these challenges in medico-legal climate in which litigation exists when complications arise for whatever reason. It is therefore more important that the principles and techniques of removing teeth are understood by all those in the dental profession who would pick up a pair of extraction forceps.

Having a tooth extracted may also pose a daunting challenge to patients whose imagination of what is to happen are often governed by misbeliefs, others experience and existing social taboos could get the better of them. Calm, reassuring approach by the dental surgeon whilst explaining the procedure goes a long way towards allowing such fears and building their confidence. The successful outcome of tooth extraction

depends not only on the surgeon's practical skills, but also on his or her ability to emphasize with patients and the way they perceive the problem.

The extraction of tooth is a surgical procedure involving bony and soft tissue of oral cavity, access to which is restricted by the lips and cheeks and further complicated by the movement of tongue and mandible. An additional hazard is that this cavity communicates with pharynx which in turn opens into larynx and oesophagus. Further this field of operation is flooded by saliva and inhabited by the largest number and variety of microorganisms. Finally it lies close to the vital centres. It is therefore essential that this aspect of oral surgery be properly understood judiciously performed and be based on sound surgical principles as it applies to any other part of human body. No operation performed by the dentist is fraught with such great danger to the patient as those of oral surgery, a large part of which is the extraction of teeth.

While the great majority of extractions can be done in the dental office, some patients require hospitalization for this surgery because of predisposing systemic conditions which increases the surgical risks.

Dental extraction has always been considered to be an unpleasant procedure for the patients due to pain



Figure 1.1: Tooth extraction: Traditional method

Introduction

phobia. With the advent of local anesthetic drugs techniques and standardization of surgical procedure, extraction is no longer considered to be painful experience to the patients. Gone are the days when extraction was supposed to be one of the crude procedure (Figure 1.1).

The control of the patient is fear and anxiety has long been a challenge to the dental practitioner. Today's extraction procedure is painless and anxiety-free provided that one employs good principles of patient management and pharmacokinetics (Figure 1.2).

In the initial few chapters of this book armamentarium required for tooth extraction, principles of exodontia, various methods of extraction are described. Then a brief idea about anatomical considerations and anesthesia is described. Next few chapters describe special techniques like pediatric extractions serial extractions and

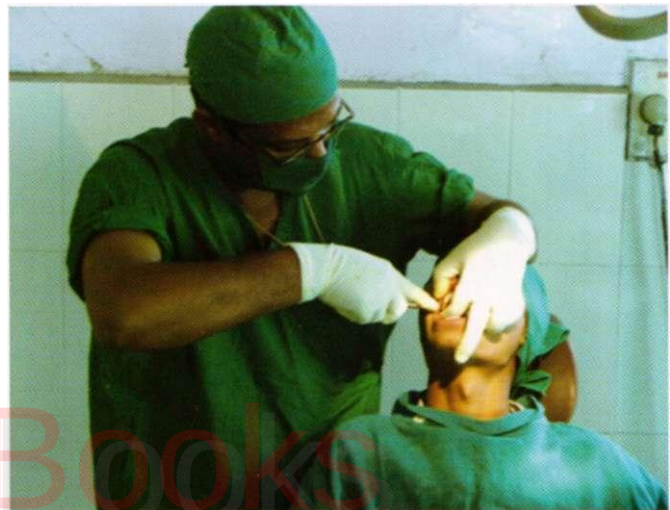
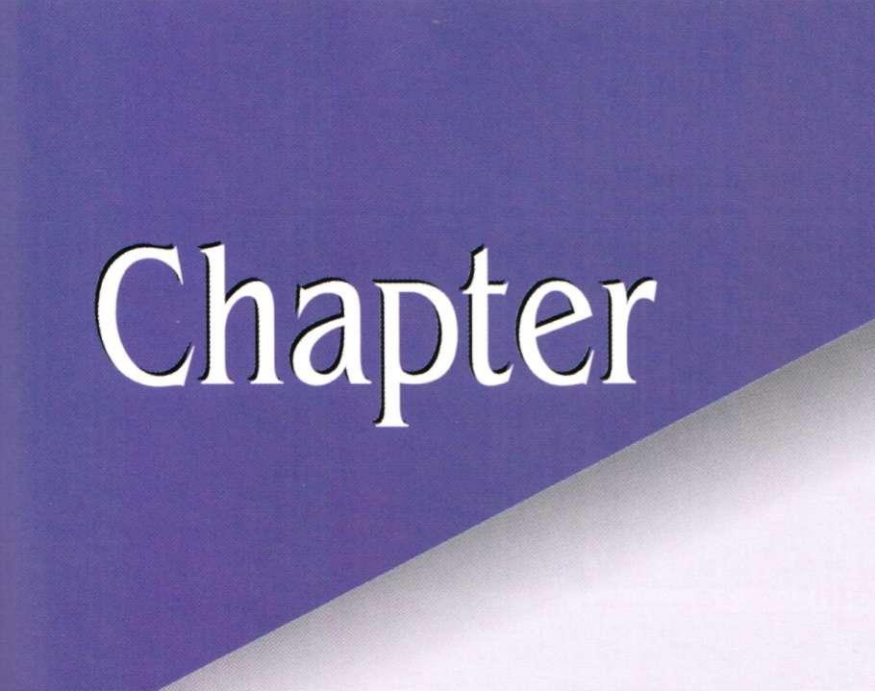


Figure 1.2: Extraction of tooth in dental office

extractions for medically compromised patients. Lastly, the complications are described in details with their management.



Chapter

Armamentarium

The purpose of this chapter is to introduce the instruments that are required to perform routine oral surgical procedures. These instruments are used for a wide variety of purposes, including both soft tissue and hard tissue procedures. This chapter deals primarily with a description of the instruments; subsequent chapters discuss the actual use of the instruments in the variety of ways for which they are intended.

INSTRUMENTS USED TO EXTRACT TOOTH (DENTAL FORCEPS)

Dental forceps were used in Greek times and were first illustrated by Albucasis. He described a short handled pairs which were first applied to the crown of the tooth to shake it up and then the long handled forceps were used to complete the extraction. Cyrus Fay in 1826 was first to describe forceps design to fit the neck of the tooth and these were said not to apply any force to the crown. The credit for anatomically designed forceps is frequently given to Sir John Toms (1841), and there is no doubt his instruments were superior to those of Fay and it is from his design modern forceps have developed (Figure 2.1).

The dental forcep is the most widely used instrument in the extraction of teeth. The use of this instrument makes it possible for the operator to grasp the root portion of a tooth and to luxate the latter from its socket by exerting pressure upon it. The forceps have blades and handles united by a hinge joint. The larger the ratio between the length of the handles and the length of the blades the greater is the force which can be exerted upon the root. The length of the handle must be such that the forceps fits the operator hand. Greater the distance between the hinge joint and operator's hand, the greater is the movement of the forceps within the hand. Thus, greater energy may be dissipated to the tooth.

The blades of the forceps are forced into the periodontal ligaments to separate it from the tooth. Thus, the blades should be always sharp. The blades of stainless steel forceps can be sharpened with a sandpaper disk applied to the outside of the tips.

Ideally the whole of the inner surface of the blade should fit the root surface. In practice the size and shape of roots vary so greatly that it is not possible to achieve this aim and root is grasped by the edges of the blades

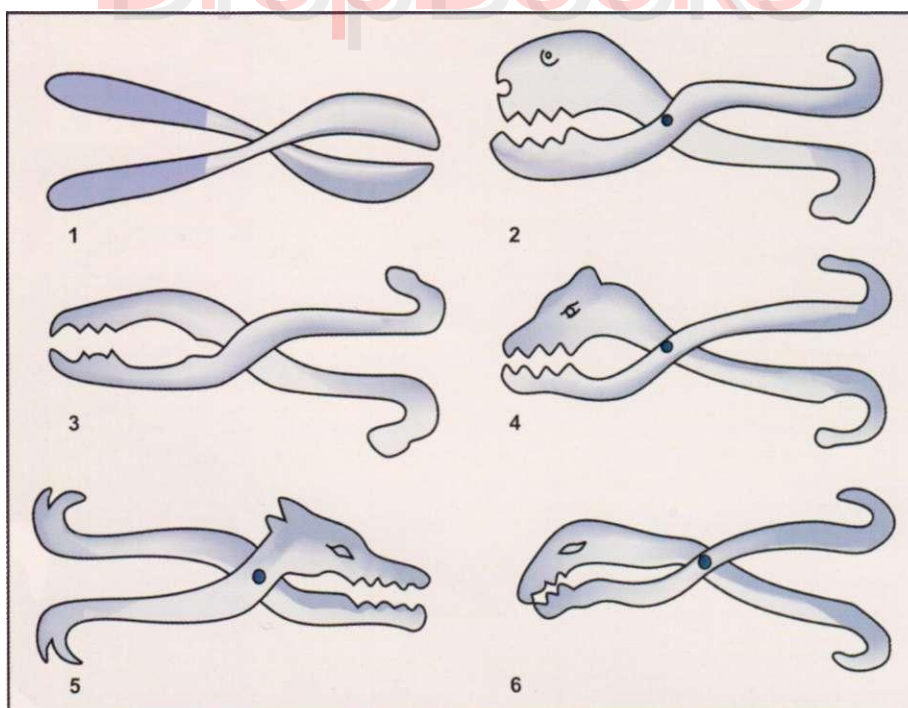
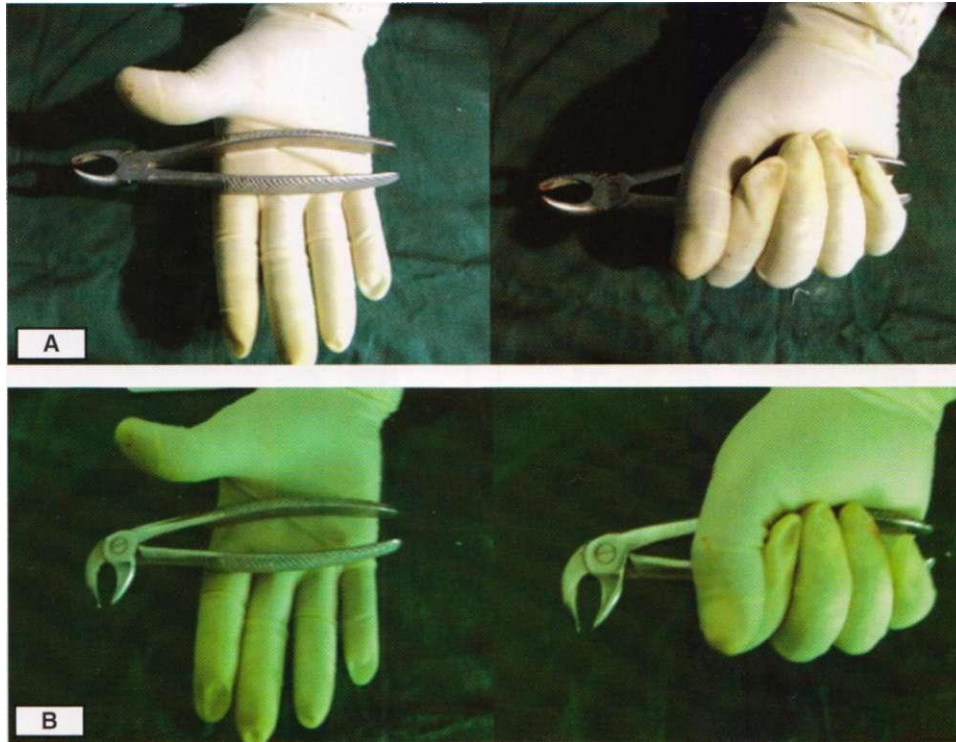


Figure 2.1: Dental forceps: Various designs in literature

Armamentarium



Figures 2.2A and B: Effective use of forceps: (A) Maxillary, (B) Mandibular

establishing a two point contact. If there is a single point contact between the tooth and blade, the tooth will probably crush when it is gripped. It is better to use forceps with blades which are slightly narrow than a forceps with blades which are too broad.

The effective use of various instrument depends on understanding the design of the instruments and their principles. Forceps permits controlled force application on the tooth that allows dilatation of alveolar socket, luxation of tooth and its subsequent removal.

The forceps can be classified as American pattern of forceps and English pattern of forceps. In the Indian subcontinent the English pattern is more popular.

The forceps used for the maxillary and mandibular teeth differ in their design.

In mandibular forceps, the beaks are at right angle to the long axis of the handle while in maxillary forceps beaks are in the same line, i.e. parallel to the long axis of the handle.

The handles of forceps are held differently depending on the position of tooth to be removed. Maxillary forceps

are held with the palm underneath the forceps. So that the beak is directed in a superior direction. The forceps used for the removal of mandibular teeth are hold with palm on top of the forceps so that beak is pointed down towards the tooth (Figures 2.2A and B).

MAXILLARY FORCEPS

Maxillary Anterior Forcep

This forcep has beaks in approximation with each other and the handle is straight without curvature. Beaks are symmetrical and are placed in the same line as the handle. Beaks are shorter than the handle. This forcep is used for the extraction of maxillary incisors and canine (Figure 2.3).

Maxillary Premolar Forcep

This forcep is having beaks which are approximating each other and placed parallel to handle. Handle is having concavity on one side and convexity on other side (Figure 2.4). This provides better grip and allows the forcep



Figure 2.3: Maxillary anterior forcep



Figure 2.5: Maxillary molar forceps (right and left)



Figure 2.4: Maxillary premolar forcep



Figure 2.6: Maxillary cow horn forceps (right and left)

to reach inside more posterior in oral cavity. This forcep is used for removal of maxillary premolars and rarely upper roots.

Maxillary Molar Forcep

These forceps are paired forceps having beaks which are asymmetrical and broader as compare to anterior forceps. The one beak is pointed to engage the bifurcation of the tooth on buccal side and other engages the palatal root. Depending upon the position of pointed beak the forceps can be identified as right and left. The handle is same as that of maxillary premolar forceps (Figure 2.5).

Maxillary Cow Horn Forcep

These are the paired forceps having design same as that of maxillary molar forceps except they are having beaks that appear as the horn of the cow and called as cow horn forceps. One beak is pointed which goes in buccal bifurcation other beak is having notch which engages the palatal root. These are paired forceps used for right and left side separately (Figure 2.6). They are used for maxillary molars which are badly carious in nature. The major disadvantage is that they crush alveolar bone when used on intact teeth.

Armamentarium

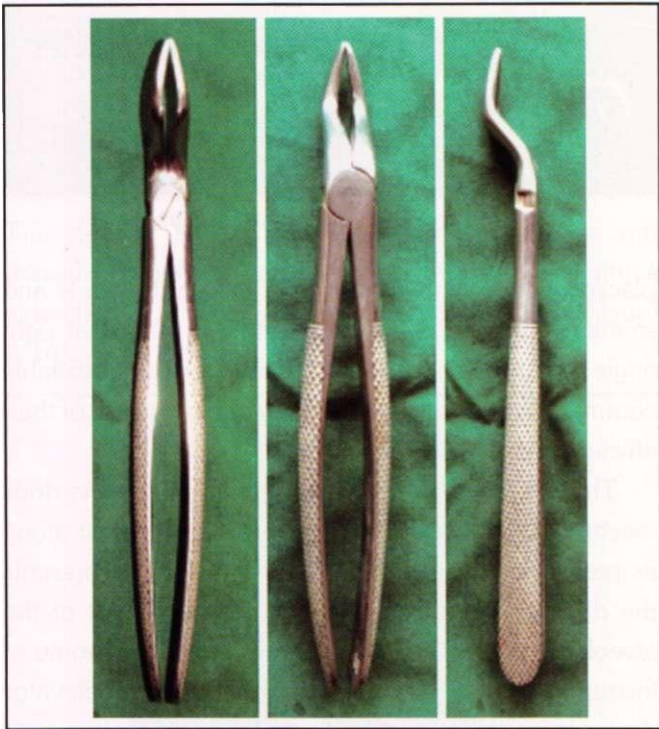


Figure 2.7: Maxillary bayonet forcep



Figure 2.8: Maxillary third molar forcep

Maxillary Bayonet Forcep

This forcep is designed for removal of maxillary roots. Beaks are symmetrical and closely approximate to each other. The beaks are narrow to fit it to the circumference of the root (Figure 2.7). Handle is having angulations so that it can reach as much posteriorly as possible.

Maxillary Third Molar Forcep

This forcep is specially designed for removal of maxillary third molar. The forceps have beaks which engage the crown of third molar and is having long handle to reach the posterior most region in maxilla (Figure 2.8).

MANDIBULAR FORCEPS

Mandibular Anterior Forcep

This forcep is having beaks similar to maxillary incisor forcep which approximate with each other. Beaks are at right angle to the handles. This forcep is used for extraction of mandibular incisor and canine (Figure 2.9).



Figure 2.9: Mandibular anterior forcep

Mandibular Premolar Forcep

This forcep has same design as that of mandibular anterior forcep except the space in between two beaks is more compared to incisor forcep to accommodate the crowns of premolar which are having greater diameter (Figure 2.10).

Mandibular Molar Forcep

These are unpaired forceps having beaks broader and stout. The beaks are symmetrically pointed so that sharp pointed tips can engage the bifurcation both at buccal and lingual surfaces. The beaks are at right angles to the handle. These forceps are used for the extraction of mandibular molars (Figure 2.11).

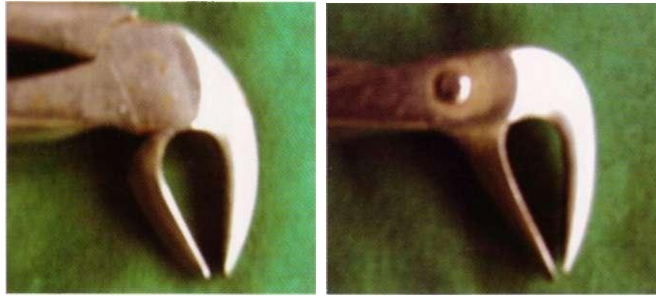


Figure 2.10: Mandibular premolar forceps

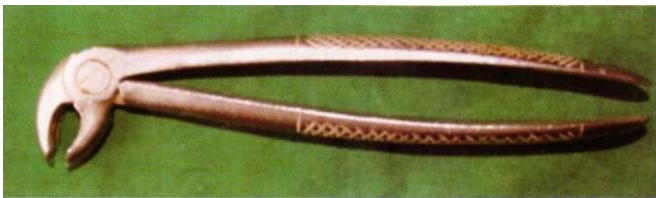


Figure 2.11: Mandibular molar forceps

Mandibular Cow Horn Forceps

The design of this forcep is same as that of mandibular molar forcep except the beaks are pointed and conical in shape. These forceps are used for the extraction of mandibular molars.

Universal Forcep

This forcep is having the beaks similar to the mandibular molar forcep except that they are facing forward towards each other at right angle to the handle. This is a specially designed forcep mainly used for extraction of third molars (Figure 2.12).

INSTRUMENTS USED FOR TOOTH LUXATION (ELEVATORS)

Elevators are the instruments used to elevate the tooth or root from the alveolar socket. Elevation of tooth before application of forcep makes a difficult extraction easy. The elevators are designed on two basic patterns. In general all the elevators have handle, shank and a blade. In the straight pattern all these three components are

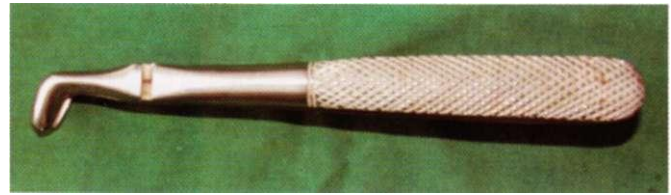


Figure 2.12: Universal forceps

placed in one plane. In the other design the blade and shank are in one plane and handle is placed at right angle to them. There are so many elevators available commercially but a few are widely used because of their efficiency and convenience.

The elevators deliver the force based on various mechanical principles to drive the tooth or root along its path of delivery or line of withdrawal. It represents the direction along which the tooth move out of the alveolar socket with economy of force and economy of instrumentation. Hence, successful use of an elevator depends on the determination of the convenient path of its delivery. Principles of use of elevators are described in the principles of exodontia chapter.

TYPES

The elevators which are widely used in the dental practice are (Figure 2.13):

1. Straight elevator
2. Apexo elevator (Right and left)
3. Cross bar elevator

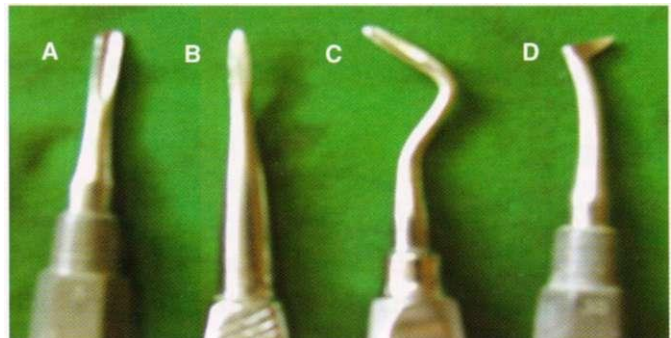


Figure 2.13: Different types of elevators. (A,B) Straight elevator, (C) Apexo elevator, (D) Cross bar elevator

Straight Elevator

The blade, handle and shaft are in one line. The blade is pointed or broad and bluff as in coupland elevator. The blade is having concave surface on one side, so that it can be used in same fashion as shoehorn. The elevator is used to elevate the mandibular and maxillary molars to luxate the teeth in case of multiple extraction. It is usually avoided in anterior teeth (Figure 2.14).

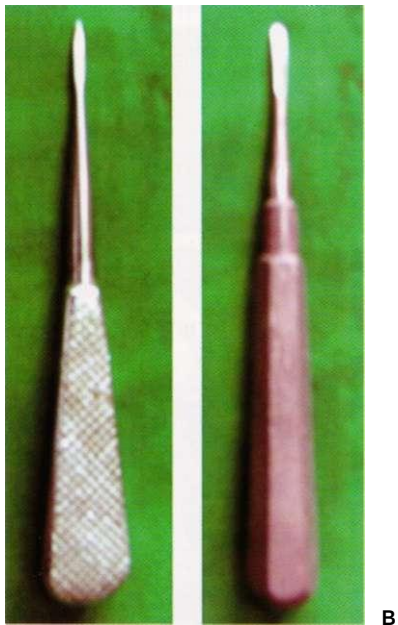


Figure 2.14: Straight elevators. A—Straight pattern, B—Coupland pattern

Apexo Elevator

These elevators are paired having handle, shank and blade which are in same plane. The blade is having angulations so that it reaches the root apices. This elevator works on the principle of wedge (Figure 2.15).

Cross Bar Elevator

These are paired elevators having blade and shank at right angle and shank and handle at right angle to each other. This is indicated for the removal of the mandibular roots where the other root has already been removed. In such cases the tip of the elevator is introduced to the depth of the empty socket with the concave surface of



Figure 2.15: Apexo elevator (Paired elevators)

the elevator facing the root to remove. By applying wheel and axle principle with rotatory movement, the inter-radicular septum and the root are elevated out of alveolar socket. The same elevator is used for elevating the distal root on the right side and the mesial root on the left side (Figure 2.16).

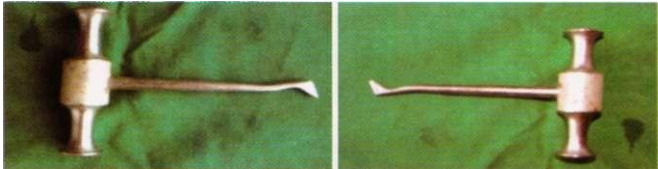


Figure 2.16: Cross bar elevators (Paired elevators)

Winter Cryer Elevator

This elevator is same as that of cross bar except handle is parallel to the working end. This is a set of elevators used for removal of root apices (Figure 2.17).

Axio Elevator

These are specially designed elevators which are used for elevation of mandibular third molars (Figure 2.18).



Figure 2.17: Winter crayer elevator (Paired elevators)

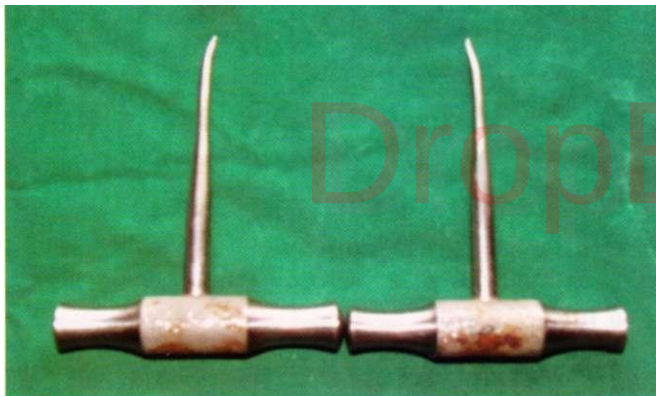


Figure 2.18: Axio elevator (Paired elevators)

INSTRUMENTS TO INCISE TISSUE

Most surgical procedures begin with an incision. The instrument for making an incision is the scalpel, which is composed of a handle and sharp blade. The most commonly used handle is the No. 3 handle, but occasionally the longer, more slender No. 7 handle is used. The tip of the scalpel handle is prepared to receive a variety of differently shaped scalpel blades that can be inserted onto a slotted receiver (Figure 2.19).

The most commonly used scalpel blade for intraoral surgery is the No. 15 blade. It is relatively small and can



Figure 2.19: Scalpels for making incision (BP handle No. 3 and No. 7)

be used to make incisions around teeth and through mucoperiosteum. It is similar in shape to the large No. 10 blade, which is used for skin incisions. Other commonly used blades for intraoral surgery are the No. 11 and the No. 12 blades. The No. 11 blade is sharp pointed blade that is used for making stab incisions, such as for incising an abscess. The hooked No. 12 blade is useful for mucogingival surgery procedures where incisions must be made on the posterior aspect of teeth.

The bard parker handle is of different number, i.e. No. 3 handle is used to receive blades No. 15, No. 11, No. 12, and No. 4 handle is used to receive No. 10 blade (Figure 2.20).



Figure 2.20: Different types of blades. BP handle blade

The scalpel blade is carefully loaded onto the handle with a needle holder to avoid lacerating the operator's fingers. The blade is held on the superior edge where it is reinforced with a small rib, and the handle is held so that the male portion of the fitting is pointing upward. The blade is then slid onto the handle until it clicks into position. The knife is unloaded in a similar fashion. The needle holder grasps the most proximal end of the blade

Armamentarium

incision penetrates the mucosa and periosteum with the same stroke. Other principles of mucoperiosteal incision and flap design are described in subsequent chapters.

Scalpel blades are designed for single patient usage. They are dulled very easily when they come into contact with hard tissue such as bone and teeth. If several incisions through mucoperiosteum to bone are required, it may be necessary to use a second blade during a single operation. It is important to remember that dull blades do not make clean, sharp incisions in soft tissue and therefore should never be used.

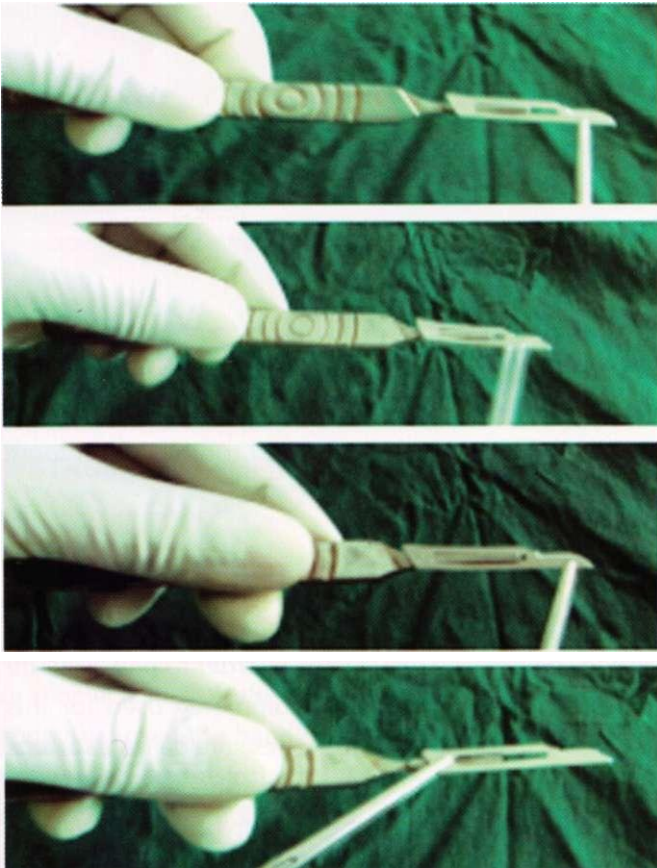


Figure 2.21: Loading and unloading of scalpel blades

and lifts it to disengage it from the male fitting. It is then slid off the knife handle in the opposite direction. The used blade is discarded into a proper container (Figure 2.21).

When using the scalpel to make an incision, the surgeon holds it in the pen grasp to allow maximal control of the blade as the incision is made. Mobile tissue should be held firmly to stabilize it so that as the incision is made, the blade will incise, not displace, the mucosa. Whole length of the blade must be drawn for incising tissue. If only one end is used cutting is inefficient and uncontrolled. When a mucoperiosteal incision is made, the knife should be pressed down firmly so that the

INSTRUMENTS FOR ELEVATING MUCOPERIOSTEUM

After an incision through mucoperiosteum has been made, the mucosa and periosteum should be reflected from the underlying bone in a single layer with a periosteal elevator (Figure 2.22). The instrument that is most commonly used is the Molt periosteal elevator. This instrument has a sharp, pointed end and a broader flat end. The pointed end is used to confirm the depth of incision and reflect dental papillae form between teeth. The broad end is used for elevating the tissue from the bone.

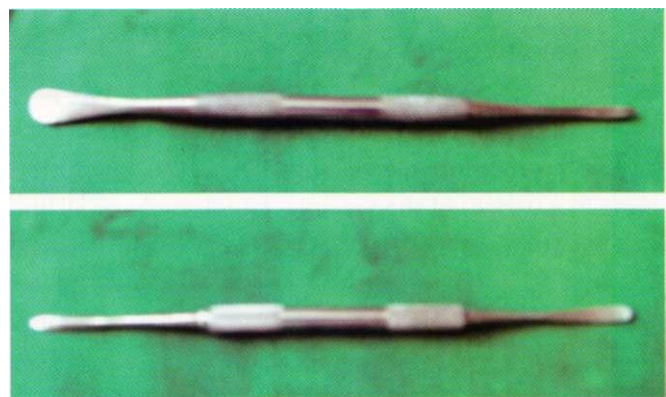


Figure 2.22: Periosteal elevators

The periosteal elevator can be used to reflect soft tissue by three methods. First, the pointed end can be used in a prying motion to elevate soft tissue. This is most commonly used when elevating a dental papilla form between teeth. Second is the push stroke in which

the broad end of the instrument is slid underneath the flap, separating the periosteum from the underlying bone. This is the most efficient stroke and results in the cleanest reflection of the periosteum. The third method is a pull stroke or scrape stroke. This is occasionally useful in some areas but tends to tear the periosteum unless it is done carefully.

The periosteal elevator can also be used as a retractor. Once the periosteum has been elevated, the broad blade of the periosteal elevator is pressed against the bone with the mucoperiosteal flap elevated into its reflected position.

When teeth are to be extracted, the soft tissue attachment around the tooth needs to be released from the tooth. The instrument most commonly used for this is the moons probe. This instrument is relatively small and delicate and can be used to loosen the soft tissue via the gingival sulcus (Figure 2.23).



Figure 2.23: Moon's probe

INSTRUMENTS FOR CONTROLLING HEMORRHAGE

When incisions are made through tissue, small arteries and veins are incised, causing bleeding that may require more than simple pressure to control. When this is necessary, an instrument called a hemostat is used. Hemostats come in a variety of shapes, may be relatively small and delicate or larger, and are either straight or curved. The hemostat most commonly used in oral surgery is a curved hemostat (Figure 2.24).

A good hemostat must have tips that opposes accurately with each other. Blades must be closed firmly on first ratchet and light should not pass through the blades when handle is fully closed. Hemostat gets spoiled if hard and bulky material is caught with it. Method of application of hemostat includes visualization of bleeding point, application of hemostat at right angle direction to direction of force of blood. Catch the tip with

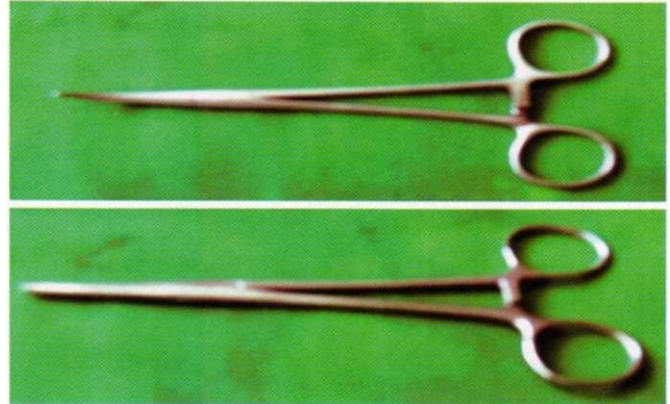


Figure 2.24: Hemostats (curved and straight artery forceps)

minimum amount of surrounding tissue as bulky ligation may slip. In addition to its use as an instrument for controlling bleeding, the hemostat is especially useful in oral surgery to remove granulation tissue from tooth sockets as well as to pick up small root tips from tooth sockets.

INSTRUMENTS TO GRASP TISSUE

In performing soft tissue surgery, it is frequently necessary to stabilize soft tissue flaps in order to pass a suture needle. Tissue forceps most commonly used for this purpose is the Adson forceps. These are delicate forceps with small teeth that can be used to gently hold tissue and thereby stabilize it. Adson forceps are also available without teeth (Figure 2.25A).



Figure 2.25A: Adson forcep

In some types of surgery, especially when removing larger amount of fibrous tissue as in an epulis fissuratum forceps with locking handles and teeth that will grip the tissue firmly are necessary. In this situation Ellis forceps are used. The locking handle allows the forceps to be placed in the proper position and then to be held by an assistant to provide the necessary tension for proper dissection of the tissue. The Ellis forceps should never be used on tissue that is to be left in the mouth because

they cause a relatively large amount of crushing injury. The Ellis forceps are most commonly used instrument having straight blades and tip slightly curved or angulated for better grip. Tip is provided with interlocking teeth. They are three to four in number and interlock with each other (Figure 2.25B).



Figure 2.25B: Ellis forcep

INSTRUMENTS FOR REMOVING BONE

RONGEUR FORCEPS

The instrument most commonly used for removing bone is the rongeur forceps. These instruments have sharp blades that are squeezed together by the handles cutting or pinching through the bone. Rongeur forceps have a spring between the handle so that when hand pressure is released the instrument will open. This allows the surgeon to make repeated cuts of bone without making special efforts to open the instrument. There are two major designs for rongeur forceps, a side-cutting forceps, end-cutting forceps (Figure 2.26).

The end-cutting forceps are more practical for most dentoalveolar surgical procedures that require bone removal. These forceps can be inserted into sockets for



Figure 2.26: Rongeur forcep

removal of inter-radicular bone. They can also be used to remove sharp edges of bone. Rongeurs can be used to remove large amounts of bone efficiently and quickly. Because rongeurs are relatively delicate instrument, the surgeon should not use the forceps to remove large amounts of bone in single bites. Rather, smaller amounts of bone should be removed in each of multiple bites. Likewise, the rongeurs should not be used to remove teeth, since this practice will quickly dull and destroy the instrument. Rongeurs are usually quite expensive so care should be taken to keep them in working order.

CHISEL AND Mallet

One of the obvious methods of bone removal is to use a surgical chisel and mallet. Bone is usually removed with a mono bevel chisel, and teeth are usually sectioned with a bi-bevel chisel. The success of chisel use depends on the sharpness of the instrument. Therefore, it is necessary to sharpen the chisel before it is sterilized for the next patient. Some chisels have carbide tips and can be used more than once between sharpening. A mallet with a nylon facing imparts less shock to the patient, is less noisy, and is therefore recommended (Figure 2.27).



Figure 2.27: Chisel and and osteotome

BONE FILE

Final smoothing of the bone before suturing the mucoperiosteal flap back into position is usually performed with a small bone file. The bone file is usually a double ended-instrument with a small and large end (Figure 2.28). It cannot be used efficiently for removal of large amounts of bone, and it is used only for final smoothing. The teeth of the bone file are arranged in such a fashion that they remove bone only on a pull stroke. Pushing the bone file results only in burnishing and crushing the bone and should be avoided (Figure 2.28).



Figure 2.28: Bone file

BUR AND HANDPIECE

A fine method for removing bone is with a bur and hand-piece. This is the technique that most surgeons use when removing bone. Relatively high-speed handpieces with sharp carbide burs remove cortical bone efficiently. Burs such as fissure bur, round bur are commonly used. Occasionally, large amounts of bone need to be removed such as in torus reduction. In these situations, a large bone bur that resembles an acrylic bur is used (i.e. carbide trimmer) (Figure 2.29).



Figure 2.29: Different types of burs

The handpiece that is used must be completely sterilizable in a steam autoclave. When a handpiece is purchased, the manufacturer's specifications must be checked carefully to ensure that sterilization is possible. It should have relatively high speed and torque. This allows the bone removal to be done rapidly and allows efficient sectioning of teeth. The handpiece must not exhaust air into the operative field as dental drills do. Most high-speed turbine drills used for routine restorative dentistry cannot be used. The reason is that the air exhausted into the wound may be forced into deeper tissue planes and produce tissue emphysema, a potentially dangerous phenomenon.

INSTRUMENTS TO REMOVE SOFT TISSUE FROM BONY DEFECTS

The curette, sometimes called the periapical curette, is an angled, double-ended instrument used to remove soft tissue from bony defects (Figure 2.30). The principle use is to remove granulomas or small cysts from periapical lesions, but it is also used to remove small amounts of granulation tissue debris from the tooth socket. The periapical curette is distinctly different from the periodontal curette in design and function.



Figure 2.30: Bone curette

INSTRUMENTS FOR SUTURING MUCOSA

Once a surgical procedure has been completed, the mucoperiosteal flap is returned to its original position and held in place by sutures. The needle holder is the instrument used to place the sutures.

NEEDLE HOLDER

The needle holder is an instrument with a locking handle and a short, stout beak. For intraoral placement of sutures, a 6-inch (15 cm) needle holder is usually recommended. The beak of the needle holder is shorter and stronger than the beak of the hemostat. The face of the beak of the needle holder is crosshatched to permit a positive grasp of the suture needle and suture (Figure 2.31). The hemostat has parallel grooves on the face of the beaks, thereby decreasing the control over needle and suture. Therefore, the hemostat should not be used for suturing.



Figure 2.31: Needle holder

In order to properly control the locking handles and to direct the relatively long needle holder, the surgeon must hold the instrument in the proper fashion.

Thumb and ring finger are inserted through the rings. The index finger is held along the length of the needle holder to steady and direct it. The second finger aids in controlling the locking mechanism. The index finger should not be put through the finger ring, because this will result in dramatic decrease in control.

SUTURE CUTTING SCISSOR

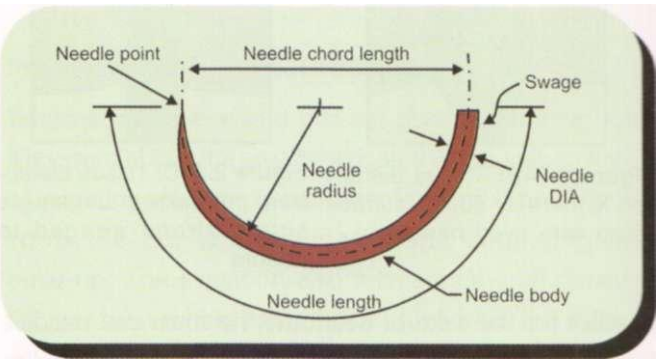
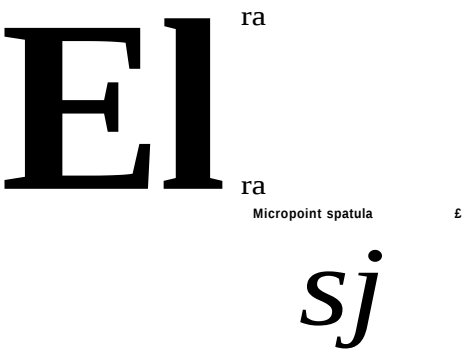
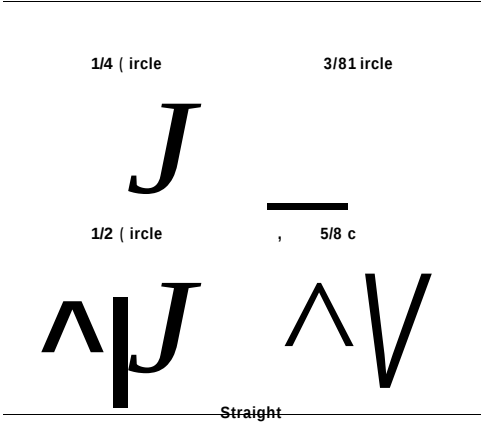
Usually sutures are cut at the end of eighth day. Scissor used for this purpose is specially designed so that it can reach to the most posterior teeth (Figure 2.32).



Figure 2.32: Suture cutting scissor

NEEDLE

The needle is held approximately two thirds of the distance between the tip and the end of the needle. This allows enough of the needle to be exposed to pass through the tissue, while allowing the needle holder to grasp the needle in its strong portion to prevent bending of the needle (Figures 2.33A to C). The needle used in closing mucosal incisions is usually a small half circle or three-eighth circle suture needle. It is curved to allow the needle to pass through a limited space where a straight needle can not reach. Suture needles come in a large variety of shapes from very small to very large. The tips of suture needles are either tapered, such as a sewing needle, or have triangular tips that allow them to be cutting needles. A cutting needle will pass through mucoperiosteum more easily than the tapered needle. The cutting portion of the needle extends about one-third the length of the needle, and the remaining portion of the needle is round. The suture can be threaded through the eye of the needle or can be purchased already swaged. If the dentist chooses to load his own



C. Anatomy of a surgical needle

Figures 2.33A to C: Shape, size and anatomy of sutural needles

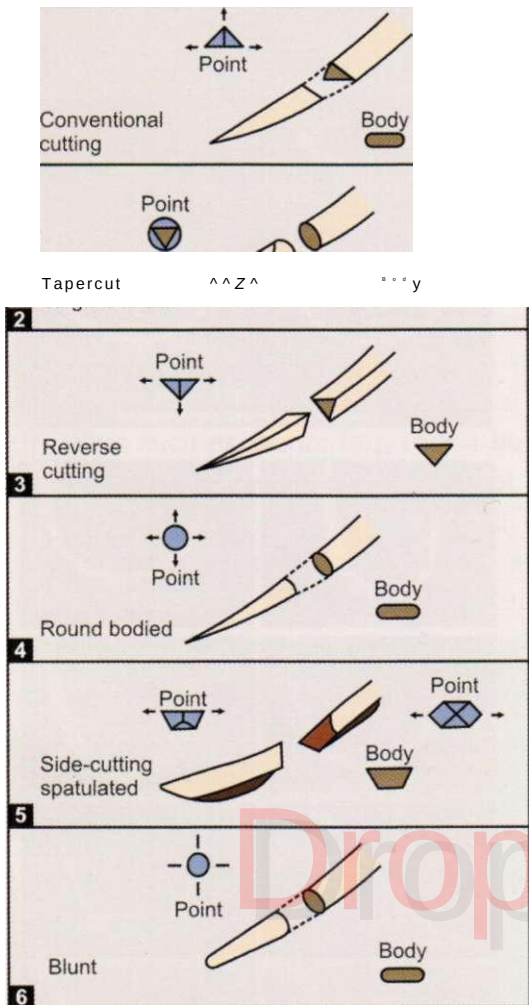


Figure 2.34A: Different shapes at needle

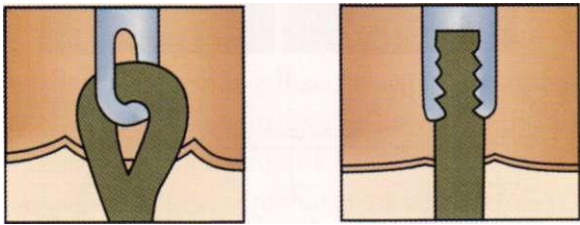


Figure 2.34B: Tissue disruption is more by double surface stand with eyed needle

Figure 2.34C: Tissue disruption minimized by single suture strand swaged to needle

needles for the sake of economy, he must use needles that have eyes, as has a typical sewing needle. Needles that have eyes are larger at the tip and may cause slightly increased tissue injury when compared to the swaged-on needles (Figures 2.34A to C).

SUTURE MATERIAL

Many types of suture materials are available for use. The materials are classified as resorbable and non-resorbable, natural and synthetic, monofilament and polyfilament.

The size of suture is designated by a series of zeros. The size most commonly used in the suturing of oral mucosa is 3-0 (000). A larger size suture would be 2-0, or 1-0. Smaller sizes would be 4-0, 5-0, and 6-0 sutures. Sutures of very fine size such as 6-0 are usually used in conspicuous places on the skin such as the face, since smaller sutures, usually cause less scarring. Sutures of size 3-0 are large enough to prevent tearing through mucosa, are strong enough to withstand the tension placed on them intraorally, and are strong enough for easy knot-tying with a needle holder.

Sutures may be resorbable or non-resorbable. Non-resorbable suture materials include types as silk, nylon and stainless steel. The most commonly used non-resorbable suture in the oral cavity is silk. Nylon and stainless steel are rarely used in the mouth. Resorbable sutures are primarily made of gut. While the term catgut is often used to designate this type of suture, gut actually is derived from the serosal surface of sheep intestines. Plain catgut resorbs relatively quickly in the oral cavity, rarely lasting longer than 5 days. Gut that has been treated by tanning solutions (chromic acid) and is therefore called chromic gut lasts longer, up to 10 to 12 days. Several synthetic resorbable sutures are also available. These are materials that are long chains of polymers braided into suture material. Examples are polyglycolic acid and polylactic acid. These materials are slowly resorbed, taking up to 4 weeks before they are resorbed. Such long-lasting resorbable sutures are rarely indicated in the oral cavity.

Finally, sutures are classified based on whether or not they are monofilament or polyfilament. Monofilament sutures are sutures such as chromic gut. If the dentist chooses to use the disposable needles, then the suture will be swaged onto the needle.

Armamentarium

INSTRUMENT TO HOLD THE MOUTH OPEN

When performing extractions or other types of surgery that requires patients to hold their mouths open widely for prolonged period of time, dentists commonly use instruments to assist patients. The bite block is just what the name implies. It is a rubber block upon which the patient can rest the teeth. The patient opens his or her mouth to a comfortably wide position and the rubber bite block is inserted, which holds the mouth in the desired position. Should the surgeon need the mouth to open wider, the patient must open wide and the bite block must be positioned more to the posterior of the mouth.

The side action mouth gag can be used by the operator to open the mouth wider if necessary. This mouth gag has a ratchet-type action opening the mouth wider as the handle is closed. This type of mouth gag should be used with caution as great pressure can be applied to the teeth and temporomandibular joint and injury may occur with injudicious use. This type of mouth gag is useful in patients who are deeply sedated.

INSTRUMENT FOR PROVIDING SUCTION

In order to provide adequate visualization, blood, saliva, and irrigating solutions must be suctioned from the operative site. The surgical suction is one that has a smaller orifice than the type used in general dentistry, so that the tooth sockets can be suctioned in case a root tip is fractured and adequate visualization is necessary. Many of these suctions are designed with several orifices, so that the soft tissue will not become aspirated into the suction hole and cause tissue injury (Figure 2.35).

The suction has a hole in the handle portion that can be covered as the need dictates. When hard tissue is being cut under copious irrigation, the hole is covered so that the solution is removed rapidly. When soft tissue is being suctioned, the hole is uncovered to prevent tissue injury.



Figure 2.35: Suction tip

INSTRUMENT TO HOLD TOWELS AND DRAPES IN POSITION

When drapes are placed around a patient, they must be held together with a towel clip. This instrument has a locking handle and finger and thumb rings. The action ends of the towel clip are sharp, curved points that penetrate the towels and drapes (Figure 2.36). When this instrument is used, the operator must take extreme caution not to pinch the patient's underlying skin.

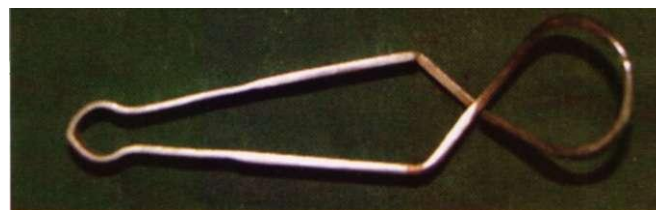
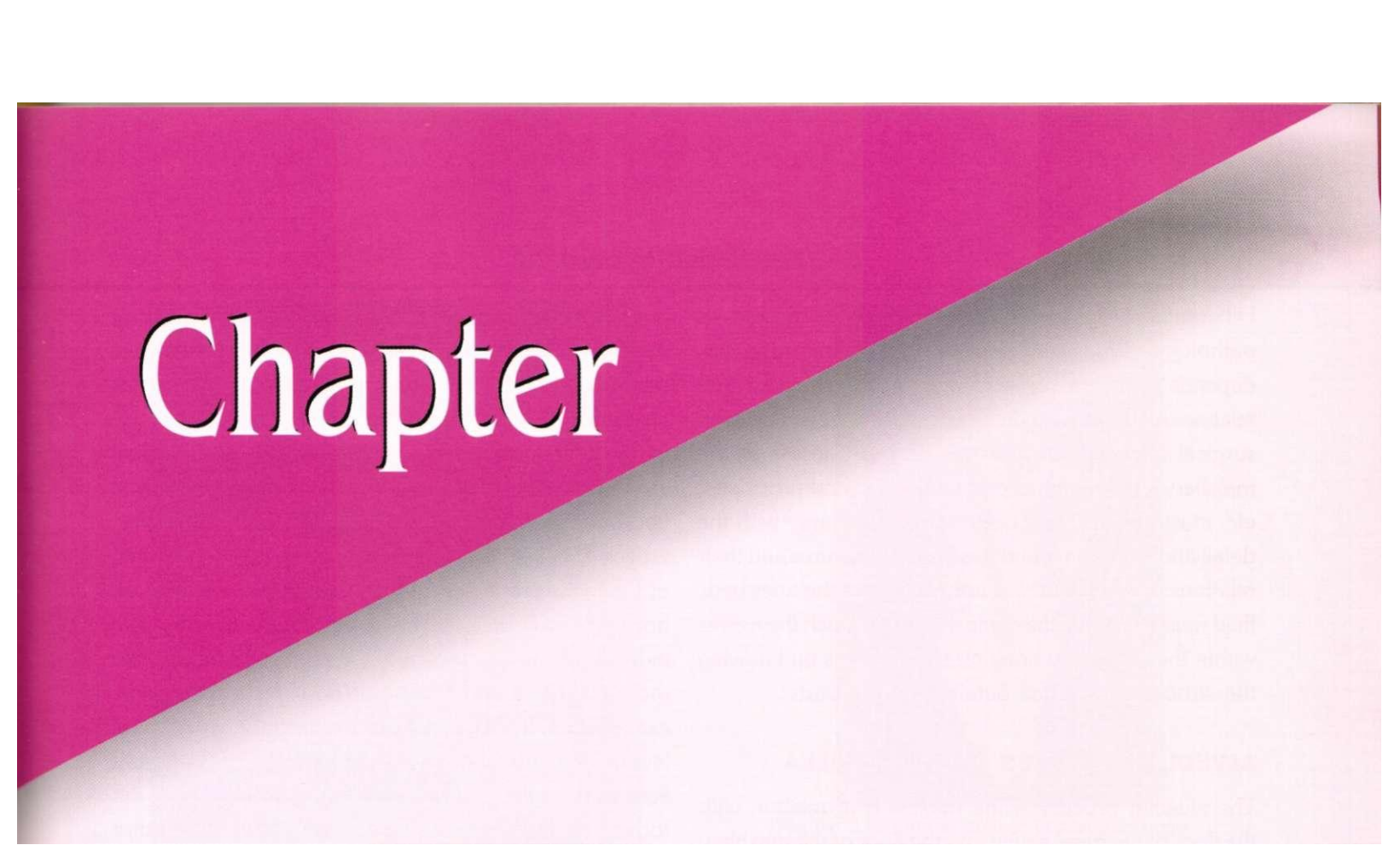


Figure 2.36: Towel clips

INSTRUMENTS FOR IRRIGATION

When a handpiece and bur are used to remove bone, it is essential that the area be irrigated with a steady stream of irrigating solution, usually sterile saline. The irrigation cools the bur and prevents bone damaging heat build-up. The irrigation also increases the efficiency of the bur by washing away bone chips from the flutes of the bur and by providing a certain amount of lubrication. Additionally, once a surgical procedure is completed and before the mucoperiosteal flap is sutured back into

position, the surgical field should be irrigated thoroughly with saline. There are two major systems for accomplishing this. The bulb syringe can be used effectively and can be refilled easily with one hand. However, the disadvantage is that it is difficult to sterilize. More commonly, a large plastic syringe with a blunt 18-gauge needle is used for irrigation purposes. Although the syringe is disposable, it can be sterilized multiple times before it must be discarded. The irrigation needle should be blunt and smooth so that it does not damage soft tissue, and it should be angled for more efficient direction of the irrigating stream.

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Chapter

Anatomical Considerations

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3

Differential diagnosis of the source, or the course, of pathology in the facial area may, in many instances, depends on depth understanding of the structure and relations of the alveolar processes. The extraction of teeth, surgical exposure of root tips, surgical access to the maxillary sinus, surgical preparation for oral prosthesis, etc. must obviously proceed from a familiarity with the detail and variation found in alveolar structures and their relations. Planning local anesthesia where the anesthetic fluid must penetrate the cortical plates to reach the nerves within the medullary bone clearly depends on knowing the structural minutiae details of these parts.

ALVEOLAR PROCESS OF THE MAXILLA

The alveolar process of the maxilla is in relation with the floor of the nasal cavity and the floor of the maxillary sinus. Its relation to these cavities is determined by the functional structure of the maxilla. The canine pillar of the maxilla, arising from the socket of the canine and extending upward along the lateral border of the piriform aperture into the frontal process of the maxilla, is the most constant bony structure in the base of the alveolar process (Figure 3.1). The canine pillar is situated lateral to the entrance into the nasal cavity. Being a functional reinforcement of the bone, it determines the medial and anterior expansion of the maxillary sinus, which replaces nonfunctional bone. It is, therefore, a general rule that the incisors are below the floor of the nasal cavity, the

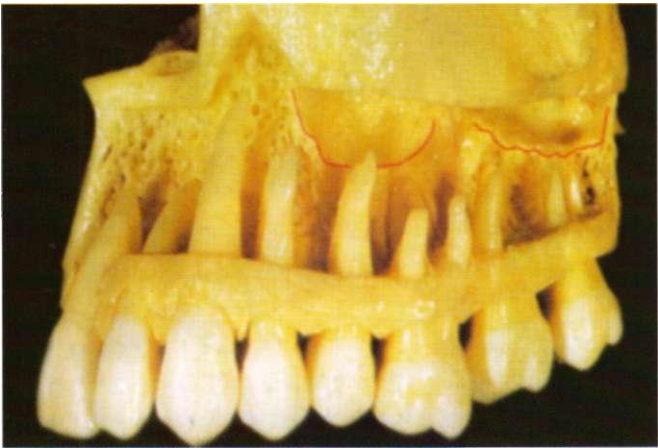


Figure 3.1: Relation of maxillary teeth with nasal floor and maxillary sinus

premolars and molars are below the floor of the maxillary sinus, and the canine occupies a neutral position between the two cavities. This is true even if the nasal cavity is abnormally wide, because the widening does not markedly involve the area in front of the incisive canal.

The relations of the apices of the incisors to the nasal floor are dependent on two factors: height of the face, especially height of the upper alveolar process, and length of the incisor roots. Since these two measurements are not correlated, it is necessary to examine each case individually and to ascertain the relations between the incisor sockets and the nasal floor by radiographic examination. It is a general rule that the root of the lateral incisor does not show as close a relation to the nasal floor as does the root of the central incisor, because the root of the lateral incisor tends to curve toward the outer rim of the nasal aperture. In addition, it has to be remembered that the floor of the nasal cavity ascends slightly laterally, which also increases the distance between the fundus of the socket of the lateral incisor and the nasal floor (Figures 3.2A and B).

In persons with a relatively short alveolar process and long roots, the central incisor may actually reach the thin

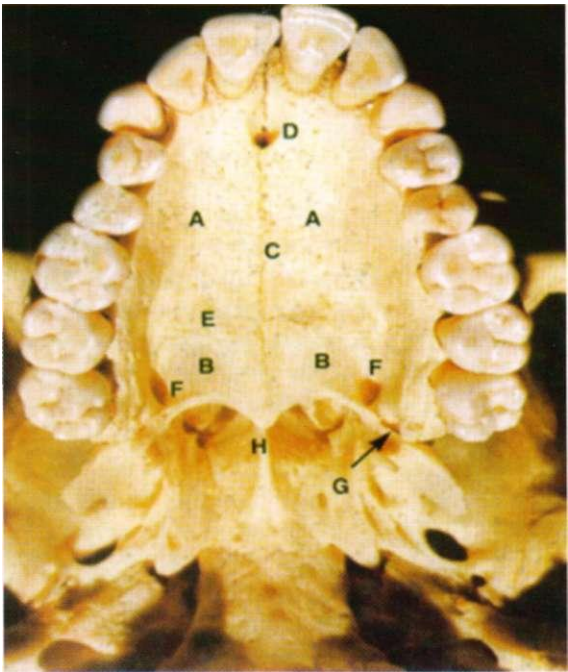


Figure 3.2A: Maxillary teeth



Figure 3.2B: Thickness of alveolar process of maxillary teeth

compact bony plate that forms the floor of the nasal cavity. The apex of the tooth is then separated from the nasal cavity by only a thin plate of bone. In the other extreme a rather thick layer of spongy bone may be interpose between the nasal floor and the socket of the central incisor.

The apex of the lateral incisor shows, in principle, the same variations in its relation to the nasal floor, but it rarely actually comes into contact with the nasal floor (Figure 3.3) The configuration of the alveolar process in the incisal region is, dependent on the formation of the palate. The inner plate of the alveolar process ascends at a moderate angle if the palate is low and then curves without a break into the horizontal roof of the oral cavity. If the palate is high, the inner plate of the alveolar process is steep in its anterior part, and there is a fairly sharp angle between the alveolar process and the roof of the mouth. These variations decisively influence the amount and the configuration of the spongy bone, the retroalveolar spongiosa, between the outer and inner



Figure 3.3: Lateral incisor in alveolar bone

plates of the alveolar process and the nasal floor. In a flat or low palate this space is roughly triangular and rather wide. In a high palate the retroalveolar spongiosa is restricted and occupies, a more rectangular area.

It has to be remembered that the difference between a low and a high palate is expressed not only in quantitative measurements but also in the changed configuration of the palate. In the incisor region the differences in shape and in the molar region the differences in relative size are more prominent, whereas the premolar area is a zone of transition. In the anterior region of the maxilla the inclination of the inner alveolar plate, or palatine plate, is slight in the low palate and steep in the high palate. In the molar region of the maxilla the angle between the oral roof and the inner surface of the alveolar process is always nearly a right angle, so that the high palate is characterized mainly by an increase in the length of the alveolar process.

The sockets of the incisors are eccentrically placed in the alveolar process, the axis of the root and socket being more nearly vertical than the axis of the alveolar process. Thus, the alveolar bone proper on the labial surface of the root fuses with the external plate of the alveolar bone, whereas palatally a wedge-shaped area

of spongy bone is found between the alveolar bone proper and the palatine or inner plate of the alveolar process. This is why abscesses originating in the incisor teeth in most instances perforate the labial plate of the alveolar process and open into the vestibule of the oral cavity. There is, however, one important exception to this rule. In a rather high percentage of incisors the apical part of the root of the lateral incisor is sharply curved lingually, and its apical foramen is placed in or near the center of the retroalveolar spongiosa and rather distant from the outer alveolar plate.

The relations of the incisors to the nasal floor explain the fact that an abscess arising from the central incisor may open into the nasal cavity or that a radicular cyst of an incisor may bulge into the inferior nasal meatus, even causing an occlusion of the nostril.

The canine is embedded in the lower part of the canine pillar of the maxilla. If this pillar contains a great amount of spongy bone, it is continuous with the retroalveolar spongiosa in the incisal region (Figure 3.4). Because of the position of the canine tooth in the canine pillar, neither nasal cavity nor maxillary sinus has intimate relations to the socket and the root of the canine. In extreme cases, however, the maxillary sinus may extend

forward so that it approaches the distolingual circumference of the socket of the canine in a rather broad front. The same is sometimes true for the nasal cavity, which approaches the mesiolingual surface of the canine. The relation of the canine to the plates of the alveolar process is, in principle, the same as that of the incisors, its root being eccentrically embedded in the alveolar process. The compactness and the size of the canine root cause an even greater bulging of the socket toward the labial surface of the alveolar process, and the alveolar eminence of the canine tooth is the most prominent in the upper jaw.

The premolars and molars are, as a rule, situated below the floor of the maxillary sinus. Whether the relations between the tooth and the sinus are intimate or not depends on the development of the inferior alveolar recess of the maxillary sinus. But even in cases in which the base of the alveolar process is deeply excavated by the maxillary sinus, the first premolar is almost always farther removed from the floor of the sinus than are the second premolar and the molars, because in the premolar area the floor of the sinus arises before continuing into the anterior wall. This, in turn, is correlated to the widening of the canine pillar at its base. Thus, with exception of extreme expansion of the maxillary sinus, the alveolar fundus of the first premolar is separated from the sinus floor by a layer of spongy bone.

The transition of the inner plate of the alveolar process into the horizontal part of the hard palate occurs in the region of the first premolar in a more pronounced angle, and differences between a low and a high palate are here of a more quantitative character than they are in the anterior region of the maxilla. The relation of the first premolar socket to the alveolar process as a whole and to the retroalveolar spongiosa varies according to the formation of the root. If the first premolar has a single root, the socket is in close relation to the outer alveolar plate and is separated from the inner plate by spongy bone. As in the incisor-canine area, the outer alveolar plate is, in reality, a fusion between the alveolar bone



Figure 3.4: Canine position in the maxillary alveolus

proper and the alveolar plate and often is extremely thin. In many persons the outer plate may even be defective, or fenestrated, especially in the apical third of the alveolar eminence. If the first premolar possesses two roots, the buccal one is closely applied to the outer alveolar plate, whereas the socket of the lingual root is placed almost in the center of the retroalveolar spongiosa.

The relation of the second premolar to the maxillary sinus is closer than that of the first premolar. Only if the alveolar recess of the maxillary sinus is absent or poorly developed does a layer of spongy bone intervene between the socket of the second premolar and the floor of the sinus. In the majority of persons the floor of the sinus dips down into the immediate neighborhood of the second premolar. Its socket is then separated from the sinus only by a thin layer of compact bone. The sinus may even extend below the level of the alveolar fundus of the second premolar, and the socket causes a slight prominence at the floor of the sinus. If the expansion of the sinus goes further, the thin bony plate between the sinus and the socket of the second premolar may

even disappear, so that only soft tissues separate the apex of the root from the cavity of the sinus; in other words, the periodontal tissue is then in direct contact with the mucoperiosteal lining of the sinus. In the region of the second premolar the inner alveolar plate is more nearly vertical, except in cases of extremely low palate. The retroalveolar spongiosa is reduced, and it almost disappears in the region of the molars (Figure 3.5).

Intimate relations between the tooth and the maxillary sinus are the rule in the region of the molars. The intervention of a substantial layer of bone between the alveolar fundus and the maxillary sinus is here an exception. The sockets of the molars almost always reach the floor of the sinus, and frequently the apices of some or all of the molar roots protrude into the sinus, where small rounded prominences at the floor of the sinus mark the position of the root apices. Bony defects at the height of these prominences are not at all rare and sometimes are of fairly large extent. The divergence of the molar roots, especially in the first molar, frequently permits an extension of the sinus downward toward the furcation of the roots. Often sickle-shaped buttresses of bone traverse the floor of the sinus in a frontal plane between the molars whose roots protrude into the sinus. Sometimes these ridges connect the prominence of one of the buccal roots with that of the lingual root. Branches of the alveolar nerves, destined for the palatal roots of the molars, use these sickle-shaped folds as bridges; they run in narrow canals that often are open toward the sinus for a variable length. The bony crests divide the alveolar process into several chambers, a peculiarity that should be kept in mind in the search for a root fragment that has been displaced into the sinus.

Differences in the relation between the first and the second molars to the sinus are caused mainly by the greater divergence of the palatal and the buccal roots in the first molar. The palatal root of the first molar frequently extends toward the base of the bony partition between the nasal cavity and the maxillary sinus and may, in extreme cases, even extend toward the lateral area of the nasal floor.



Figure 3.5: Premolar in maxillary alveolar bone showing relation with maxillary sinus

Behind the socket of the upper third molar the posterior end of the alveolar process forms a variably large knob-shaped bony prominence, the alveolar tubercle. The junction of the maxilla and the pterygoid process of the sphenoid bone, mediated usually by the palatine bone, occurs at a variable level-above the free margin of the alveolar process behind the last molar. If this junction is high and if the alveolar tubercle is hollowed out by the maxillary sinus, the bone behind the maxillary third molar is weak. If the extraction of a third molar is attempted by applying an instrument that exerts pressure distally, the entire corner of the maxilla may be broken off and the wisdom tooth is not removed from its socket, but the tooth and socket are separated from the maxilla. As a consequence of this fracture, the oral cavity and the maxillary sinus communicate through a wide opening. The possibility of this alveolar fracture should caution against attempts to extract or to loosen the upper third molar by introducing an elevator between the second and third molars and exerting pressure distally.

The vertical position of the inner plate of the alveolar process in the molar region restricts the retroalveolar spongiosa to small areas lingual to the mesiobuccal root because the lingual root is situated alongside the

distobuccal root. The socket of the lingual root fuses with the inner plate of the alveolar process or is at least close to it. Mesial to the lingual root, however, a block of spongy bone intervenes between the socket of the mesiobuccal root and the lingual plate of the alveolar process. This arrangement of the spongy bone is the rule in the region of the first and the second molars; it is, however, often obscured around the third molar because of the great variability of third molar roots (Figure 3.6).

ALVEOLAR PROCESS OF THE MANDIBLE

Conforming to the great strength and more uniform solidity of the mandible, the lower alveolar process is in most areas far stronger than that of the upper jaw. Only in the incisor and canine areas are the outer and inner plates of the alveolar process thin; distally, however, they increase rapidly in thickness (Figure 3.7).

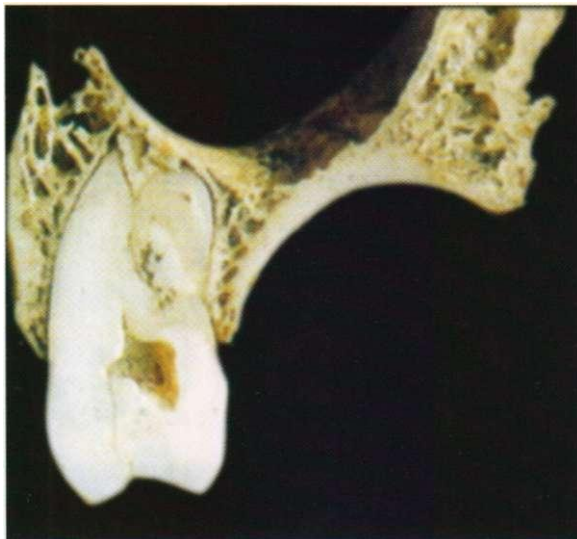
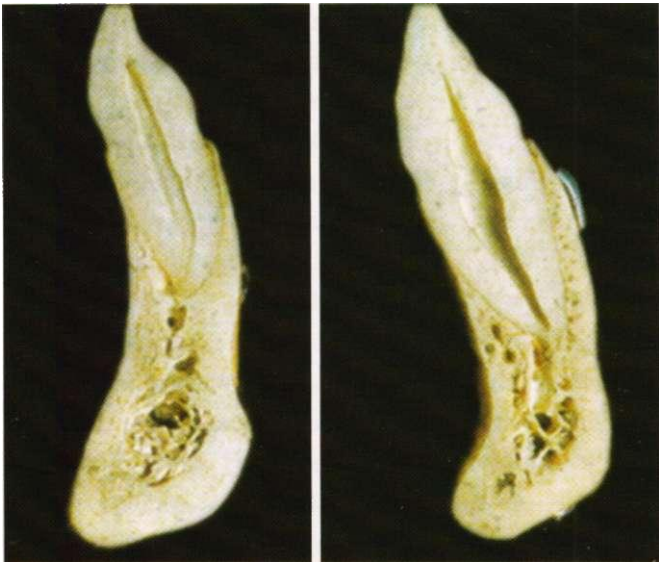


Figure 3.6: Position of the molar in maxillary cellular process



Figure 3.7: Alveolar process of the mandible

It is of clinical importance that the relation of the alveolar bone proper to the compact plates and the spongiosa of the alveolar process varies widely. In the anterior part of the mandible, in the region of the incisors and the canine, the alveolar process is narrow in the labiolingual direction, and in most jaws the alveolar bone proper fuses for the entire length of the root, or at least for most of its length, with the outer and the inner alveolar plates (Figures 3.8A and B). Only rarely is there a restricted zone of spongiosa lingual to the apical part of the socket.



Figures 3.8A and B: (A) Incisor and canine in mandibular alveolar process

The position of the sockets of the premolars and molars in the spongy bone of the mandible varies (Figure 3.9). Only infrequently is the socket symmetrically placed between the outer and inner plates. In most cases the position of the socket is asymmetrical; that is, the axis of the root and the socket is inclined against the axis

of the alveolar process. The alveolar bone proper is then fused for a variable length with one of the alveolar plates.

The premolars and the first molar are mostly in close relation to the outer alveolar plate. The second and third molars, however, often show a reversed relation, which is almost a rule for the third molar. This is not so much the consequence of a different inclination of the last mandibular teeth but of a medial shift of the alveolar process itself in relation to the bulk of the mandibular body. The oblique line on the outer surface of the mandible in the region of the second and third molars, and a fairly thick layer of spongy bone is interposed between the socket and the outer compact layer of the bone, but this bone cannot be regarded as part of the alveolar process in a strict sense. The described relations are of clinical importance because an inflammation originating in the second and especially in the third molar will often perforate the inner plate of the mandible. The variable relations of the socket and root can best be evaluated in buccolingual sections through the mandible at the level of the third molar. In such sections the socket of the wisdom tooth projects on the inner, or medial, surface of the mandible somewhat like a balconu. and

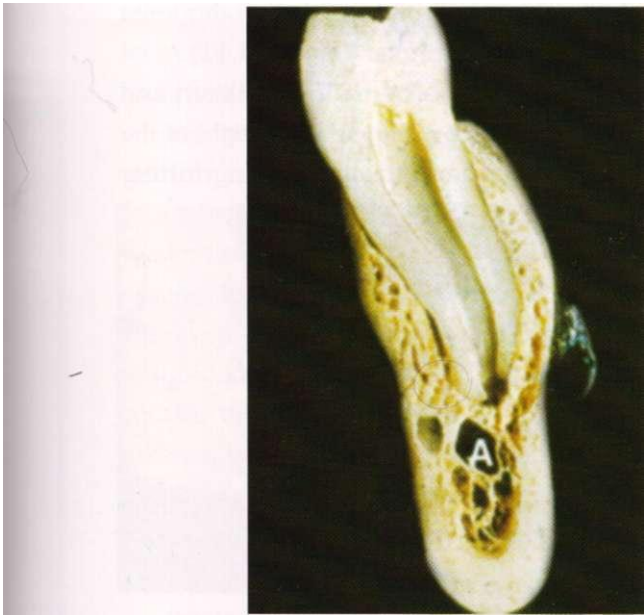


Figure 3.9: Position of premolar in the mandibular alveolar process

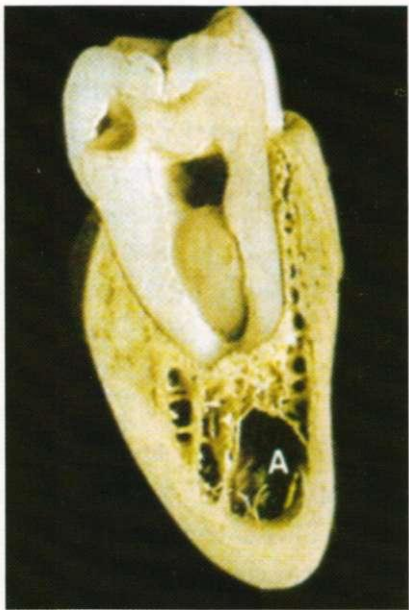


Figure 3.10: Position of molar in the mandibular alveolar process

in some persons it is shifted entirely inside the arch of the mandibular body. The further the socket projects inward, the thinner is its lingual wall and the closer is the apex of the root to the inner surface of the bone (Figure 3.10).

At or above the level of the fundus of the socket the mylohyoid line can be seen on the medial surface of the jaw. The variations in the relation of this line to the third molar are of great importance because the mylohyoid muscle, which forms the floor of the oral cavity, is attached to this line. The relations of the mylohyoid line to the apex of the third molar depend on three factors: the height of the mandibular body, the anteroposterior length of the mandibular alveolar process, and the length of the roots of the third molar. The level of the apex of the third molar roots is found, as a rule, below the level of the mylohyoid ridge, especially if the roots of the wisdom tooth are long, if the alveolar process is relatively short, and if the mandibular body is of below-average height. It is clear that in such cases a perforating abscess of the wisdom tooth will not appear in the oral cavity but below its floor in the connective tissue of the submandibular region. Lateral, or buccal, to the alveolus of the lower third molar, the massive bone forms either a variably wide horizontal edge or a variably wide and variably deep groove. The outer edge of this bony field is the oblique line where it turns anteriorly and inferiorly in continuation of the anterior border of the mandibular ramus. According to the relative length of the alveolar process, the wisdom tooth is either entirely in front of the ascending ramus or its distal part is flanked by the most anterior part of the ramus. In the latter case the accessibility of the lower wisdom tooth is restricted; especially if the superficial tendon of the temporal muscle is well developed and accentuates the anteriorly projecting border of the ramus.

Of special importance are the relations of the lower teeth to the mandibular canal and to its contents, the inferior alveolar nerve and the accompanying blood vessels. The second premolar and the molars may be rather close relation to the mandibular canal itself,

whereas the first premolar shows relation to the mental canal. Canines and incisors are placed in the region of the narrow incisive canal, the anterior continuation of the mandibular canal.

In the relation of the root apices to the mandibular canal three types can be established. The most frequent type is that in which the canal is in contact with the alveolar fundus of the third molar, and the distance between the canal and the roots increases anteriorly. When the canal is in proximity to the third molar root, the thin lamella of bone that bounds the mandibular canal may even show a fairly large defect, and the periapical connective tissue of the third molar is in direct contact with the contents of the mandibular canal. Severe pain of a neuralgic character after the extraction of a lower wisdom tooth or during inflammations of its periodontal ligament is easily explained by these relations.

The other two types of topography of the mandibular canal occur only in a small number of persons. In cases of a relatively high mandibular body combined with roots of moderate length, the mandibular canal has no intimate relations to any one of the posterior teeth. The reverse is true in those who have a low mandible and relatively long roots. In these cases the mandibular canal may be in close contact with the roots of all the three molars and the second premolar (Figure 3.11).

The last-described type is normal for children and most young persons in whom the definite height of the mandible has not yet been attained. During further

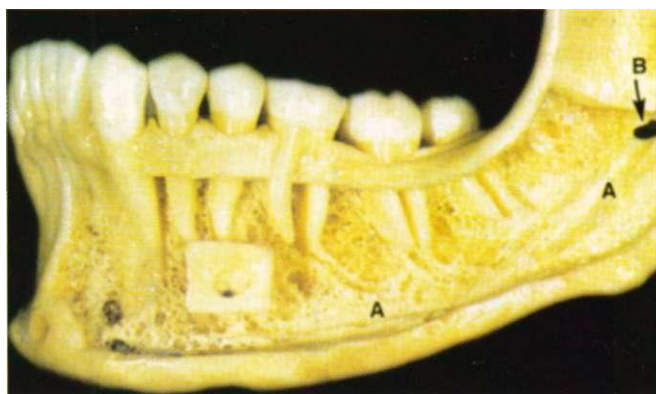


Figure 3.11: Relation of tooth apices with inferior alveolar nerve and mandibular canal

growth, the mandibular body increases in height by apposition at the free border of the alveolar process, and the teeth, by their correlated vertical eruption, move away from the mandibular canal.

The frequent impaction of the lower third molar may bring about a still closer and more complicated relation of its root to the mandibular canal and its contents. In impaction of the wisdom tooth the developing roots grow into the bone. If the tooth is in an oblique or nearly vertical position, and if the growing roots are not stunted or bent, they frequently extend beyond the level of the mandibular canal. However, an actual meeting between roots and canal is rare, although a routine radiograph may give this illusion. Since the impacted lower third molar is usually lingually inclined, its roots pass the mandibular canal on its buccal side. Only in a minority of cases are the roots located lingual to the canal if the wisdom tooth is abnormally inclined and especially if there is a considerable lingual shift of the posterior end of the alveolar process.

In rare instances the roots of an impacted third molar grow straight toward the mandibular canal and then, continuing to grow, envelop its contents. The wisdom tooth then has a root that is, to a variable extent, divided into a buccal and a lingual part. The mandibular canal may lie in this abnormal bifurcation, or, if the apices of the roots fuse below the canal, the alveolar nerve and blood vessels may pass through a canal in the roots of the wisdom tooth. The complications caused by this fortunately rare situation during extraction of such a wisdom tooth are self-evident. It is as though the loosened wisdom tooth were held in its socket by an elastic band. Cutting of this "band" means cutting the alveolar nerve and blood vessels. In view of these complications, the routine radiographs should be supplemented by one taken in vertical projection with the film in the occlusal plane. If by such a picture the diagnosis of the described situation can be made, division of the wisdom tooth

into a buccal and a lingual part should be attempted to liberate the contents of the mandibular canal.

The relations of the first premolar to the mental canal and foramen deserve special attention. Ordinarily the mental canal arises from the mandibular canal in the plane of the first premolar; sometimes its origin is slightly distal to this plane. From its origin inside the mandible, the short mental canal runs outward, upward, and backward to open at the mental foramen, situated between the two premolars or in the plane of the second premolar. The oblique course of the mental canal makes it understandable that its outer end is at a higher and more posterior level than its inner end. This explains the fact that in radiographs the mental foramen often is projected on the apex of the second premolar but rarely on the apex of the first premolar. Since at this point the mandibular canal is seldom in the immediate contact to the apices of these teeth, the mental foramen appears to have no connection with the mandibular canal and often is diagnosed wrongly as a pathologic defect of the bone, for instance as a periapical granuloma.

It was mentioned that in the premolar and molar region the outer and inner plates of the lower alveolar process consist of a fairly thick layer of compact bone. Attempts to anesthetize the inferior dental nerves by subperiosteal or supraperiosteal injections in this region are failure. In the region of the canine and incisors this method of injection is successful if the anesthetic is injected into the mental fossa above the mental tuberosity. Two facts make it advisable to inject fairly close to the lower border of the mandible and rather far below the level of the apices of the anterior teeth. The first fact is that the incisal canal is situated at a lower level than the mandibular canal itself; the second is that the outer compact of the mandible in the mental fossa is always perforated by a few small openings that allow an entrance of the injected fluid into the spongy core of the bone and thus to the incisive nerve.

Chapter

Indications and Contraindications



INDICATIONS

Following are the indications of exodontia.

PERIODONTAL DISTURBANCES

They form the common cause for dental extraction in India. When the teeth are periodontally involved, the clinician must decide whether to extract the tooth or not. The final decision depends on (a) the success of periodontal therapy, (b) patient's attitude towards the concept of conserving such teeth and (c) economic and time factors. Even if the patient desires to save the tooth, loss of more than 40% of periodontal support warrants extraction.

DENTAL CARIES

When the tooth is extensively damaged by dental caries, the dental surgeon must evaluate the feasibility of conserving the carious tooth. Even if the patient and the dental surgeon desire to save the tooth, it is indicated for extraction if all the conservative procedures have failed. This may be either because of technical reasons or if the patient fails to cooperate. Sometimes, the sharp margins of the teeth repeatedly ulcerate the mucosa. Multiple carious teeth may lead to deteriorating oral hygiene. In such cases, removal of teeth will improve the oral hygiene.

PULP PATHOLOGY

If endodontic therapy is not possible or if the tooth is having pulpal pathology, extraction is indicated.

APICAL PATHOLOGY

If the teeth fail to respond to all conservative measures to resolve apical pathology, either because of technical reasons or because of the systemic factors, such teeth are indicated for extraction before the apical pathology widens with the consequent involvement of the adjoining teeth.

ORTHODONTIC REASONS

During the course of orthodontic treatment, a few teeth may require extraction. They fall into any one of the following reasons:

Therapeutic Extractions

To gain space during the realignment of malposed teeth, extraction of teeth like premolars or molars are indicated.

Malposed Teeth

The teeth in the dental arch are malpositioned. Orthodontist may find it difficult to realign them. In such circumstances, those teeth are indicated for extraction.

Serial Extraction

During mixed dentition period, dental surgeon may have to extract a few deciduous teeth in a chronological order to prevent malocclusion as the child grows. As part of preventive dentistry, judicious extraction of deciduous teeth provides enough space eruption of permanent successors in a sequential way. This is known as serial extraction. However before advising extraction, these teeth require proper evaluation and expert orthodontic opinion. Otherwise, instead of achieving stability of the dental arch, injudicious extraction can lead undesirable esthetics like spacing between teeth may even produce unacceptable facial profile. Therefore, decision for extraction of teeth for orthodontic reasons should be based on:

- a. Orthodontic assessment
- b. Evaluation of the soft tissues like lips, tongue, etc.

PROSTHETIC CONSIDERATIONS

Extraction of teeth is indicated for providing efficient dental prosthesis. For example, to provide better design and success of partial dentures, a few selected teeth may have to be extracted. At the same time, caution is required if a patient requests the dental surgeon to extract a few

Indications and Contraindications

remaining teeth to enable him to have complete dentures. It is a known fact that atrophies of the bone results in decreased denture bearing area and the consequent decreased denture stability. But the retention of a few teeth like canines control the atrophy of the jaws. Likewise, intentional retention of a few teeth may be helpful to utilize them as abutments. Hence, careful evaluation by the prosthodontist is necessary for extracting teeth for prosthetic considerations.

IMPACTIONS

Retention of unerupted teeth beyond the chronological eruption may sometimes be responsible for facial pain, periodontal disturbances of the adjoining teeth temporomandibular joint problems, bony pathology like cysts and pathological fracture of the jaws. Impact ions may predispose to anterior overcrowding of teeth. Careful evaluation of such patients including general condition and professional competence of the dental surgeon are some of the important considerations for removal of such impacted teeth.

SUPERNUMERARY TEETH

These teeth may be malpositioned or unerupted. Such teeth predispose to malocclusion, periodontal disturbances, facial pain, bony pathology or may even predispose to esthetic problems. Unless retention of such supernumerary teeth are advantageous to the patients, they are indicated for extraction.

TOOTH IN THE LINE OF FRACTURE

This has been controversial over the course of years. The present concept is to extract the tooth in the line of fracture if (a) it is a source of infection at the site fracture, (b) the tooth itself is fractured, (c) the retention may interfere with fracture reduction or with healing of the fracture. Formerly, all the teeth in the line of fracture were routinely removed. But now, a conservative approach is advocated and hence extraction of such teeth requires guarded approach.

TEETH IN RELATION TO BONY PATHOLOGY

They are indicated for extraction. For example, they are involved in cyst formation, neoplasm or osteomyelitis, extraction is indicated. However, carefully evaluation is required before extracting teeth involved in the cyst formations. If any chance exists for guiding the tooth to erupt to normal occlusion, efforts must be directed to conserve such teeth. Hence, proper decision must be taken based on the individual case.

ROOT FRAGMENTS

They may remain dormant for a long period. Hence, every patient must be carefully evaluated to decide whether removal of root fragments is necessary. For example, roots may be at the submucosal level producing recurrent ulceration under the denture. Such ulceration may be painful or may undergo neoplastic changes. Such roots warrant removal. Sometimes, root fragment may be involved in the initiation of bony pathology like osteomyelitis, cyst or neoplasm. If such fragments are in close association with neurovascular bundle, the patient may complain of facial pain or numbness. Statistically, it has been observed that many broken root fragments remain symptomatic. This has resulted in the controversy as to whether they are indicated for removal. As a general rule, very small fragments may be left alone and the patient is to be kept under periodical observation. All the other root fragments are indicated for removal. As the age advances, the patients become medically compromised. Hence, removal is indicated as soon as it is diagnosed, instead of waiting for the symptoms to appear before general health of the patient presents any problems.

TEETH PRIOR TO IRRADIATION

Irradiation is one of the modalities of treating oral carcinomas. Previously as a prophylactic measure, all the teeth in the region of irradiation used to be extracted. But now, all the precautions are taken to conserve the teeth prior to irradiation. Hence, all the patients before

irradiation must be carefully examined so that a decision is taken regarding the extraction of such teeth. If the oral hygiene can be maintained satisfactorily, routine prophylactic extraction of these teeth are not to be encouraged. Only teeth which cannot be maintained in a sound condition require removal.

FOCAL SEPSIS

Sometimes, teeth may appear apparently sound. But radiological evaluation is a guiding factor to decide whether any teeth are to be considered as foci of infection. In such circumstances, weightage is in favor of the underlying systemic disorders like dermatological lesions, facial pain, uncontrollable ophthalmic problems etc. In such conditions, doubtful teeth are extracted instead of resorting to any conservative methods of management.

ESTHETICS

Due to certain compelling reasons like marriage and job opportunities, some teeth may require attention for esthetic considerations. But due to time factor, it may not be possible to improve esthetics by any conservative orthodontic or surgical means. If so, such teeth are indicated for extraction, provided it is followed by immediate prosthetic restoration in a shorter duration.

ECONOMIC CONSIDERATIONS

Sometimes, the dental surgeon and the patient are faced with economic constraints even though technically conservation of teeth may be feasible. In such cases, extraction may be the only other alternative method of choice. However, the benefit of doubt is left to the discretion to the patient in such circumstances and extraction of teeth is indicated as a last resort.

CONTRAINDICATIONS

Even if the tooth is indicated for removal, the presence of certain factors makes the tooth contraindicated for

extraction. They may be relative or absolute contraindications. They can be considered relative, if the contraindication is provided with additional care, one can overcome the complication. In other words, given the situation, the patient is made fit to undergo extraction, once the underlying condition is treated. On the contrary, there are a few conditions which are absolute contraindications. These factors will be the impediments for extraction, even if care is taken. If extraction is carried out in the presence of such absolute contraindications, the outcome may be even fatal. Hence, it is essential to differentiate between these two types of contraindications. To avoid legal consequences, it is preferable to avoid extraction, if the contraindication is absolute.

The contraindications may also be classified as systemic or local factors. The presence of absolute systemic contraindications indicates that this group of diseases exists in an uncontrolled state. No attempt should be made by the dental surgeon to thrust extraction on such patients. By doing so the clinician will be inviting disaster, e.g. (a) metabolic disorders like uncontrolled diabetes, (b) uncontrolled cardiac problems, (c) leukemia (d) renal failure and (e) liver disorders like cirrhosis of liver. On the contrary, the following contraindications are examples of relative contraindications. That means, extraction is to be deferred until the underlying conditions deserve attention to make the patient fit to undergo extraction. In such patients, the underlying condition is to be treated by way of precautions so that; complications can be avoided due to extraction.

DIABETES AND HYPERTENSION

Usually patients with these systemic problems are under medication to keep them under control. Hence, patients with controlled hypertension and diabetes can undergo extraction. However, it is good to investigate the state of these disorders in every patient and extraction should be carried out only after confirming that they are under control. Such precautions will be a sure way of preventing any potential complications subsequently.

Indications and Contraindications

PATIENTS ON STEROID THERAPY

If patient gives history of cortisone therapy, then, dental surgeon has to take certain precautions. A physician's opinion must be taken. Otherwise, the normal precaution would be to safely double the dose of steroid, one or two days prior to extraction and to continue one or two days postoperatively. Then, the dose must be tapered gradually to the usual dose. Otherwise, the patient is liable to exhibit adrenal crisis due to stress.

PREGNANCY

The clinician should bear in mind the existence of the possibility of obstetric complications during the first and the last trimester. Hence, if possible, extraction can be carried out after obtaining the obstetrician's expert opinion.

BLEEDING DISORDERS

The patients who give definite history of bleeding episodes need careful evaluation. It is not an absolute contraindication. Complications can be avoided, if the patient is properly evaluated and adequate precautions are taken. If necessary, close coordination with the

hematologist is necessary to ensure uncomplicated recovery of the patient following dental extractions. Patients with anticoagulant therapy can undergo extraction after obtaining prior advice from the patient's physician/cardiologist.

MEDICALLY COMPROMISED PATIENTS

In general, it is better to evaluate these patients preoperatively. Great caution should be exercised before treating this group of patients. Failure to do so may result in systemic complications.

ACTIVE INFECTIONS

These are relative contraindications. For example, extraction in the presence of active and uncontrolled infection will lead to the regional or systemic spread. Hence, it is preferable to control the infection and extraction can be safely carried out under the umbrella of antibiotic therapy.

EXTRACTION OF TEETH IN RECENTLY IRRADIATED PATIENTS

These cases deserve special mention. Irradiation of the jaws reduces blood supply due to fibrosis.

Chapter

Principles of Exodontia

5

Exodontia Practice

Dental extraction has always been considered to be an unpleasant procedure for the patients due to pain phobia.

Geoffrey L Howe: The ideal tooth extraction is the painless removal of the whole tooth, or tooth root, with minimal trauma to the investing tissues, so that the wound heals uneventfully and no post-operative prosthetic problem is created.

Extraction procedure can be:

1. Simple exodontia or closed method of extraction or intraalveolar extraction
2. Complicated exodontia or open method of extraction or transalveolar extraction

Complex extractions are defined as those extractions, not involving impaction, which cannot be removed by a simple application of elevators and forceps. Complex extractions are retrieval of tooth root and teeth which are likely to fracture or for some other reason and have an obstacle to extraction.

Extraction of teeth is a surgical operation involving the bony and soft tissues of the oral cavity, access to which is restricted by the lips, cheeks, tongue and movements of the mandible.

Additionally the oral cavity communicates with the pharynx, which in turn opens into the larynx and esophagus. The field of operation is flooded by saliva and is inhabited by the largest number of greatest variety of microorganisms found in the human body. It also lies close to the vital centers. Extraction of teeth is a procedure that incorporates principles of surgery, and many from physics and mechanics. Most of the teeth can be removed intact after these principles are followed strictly. Atraumatic extraction of tooth is a procedure that requires finesse, knowledge and skill on part of the surgeon. It is essential to give some careful study and application of sound surgical principles as is given to surgery in any other part of the body.

OBJECTIVES

Extraction is one of the most common surgical procedures performed by dental or an oral surgeon. The main

objective is to serve the periodontal attachment carefully and elevate the tooth out of alveolar socket without damaging the adjacent structures. While doing extraction certain amount of trauma is inevitable. Hence, success in exodontia depends on how the trauma is kept minimum. The skill and practical wisdom of any clinician is directly proportional to personal experience and the knowledge gain.

In general, according to difficulty faced the cases are classified into four types:

Type 1—easy patient easy case

Type 2—easy patient difficult case

Type 3—difficult patient easy case

Type 4—difficult patient difficult case

Every clinician should bear in mind this classification as a general rule before undertaking every minor surgery.

GENERAL PRINCIPLES INVOLVED IN EXODONTIA

- Clinical evaluation
- Radiographic evaluation
- Patient and surgeon preparation
- Patient position
- Operator position
- Principles of extraction
- Principles of elevators
- Postoperative instructions

BASIC REQUIREMENTS

Following are the basic requirements of exodontia:

1. A good radiograph
2. Adequate anesthesia
3. Instruments
4. Adequate illumination
5. Efficient assistance
6. Suction apparatus

CLINICAL EVALUATION

In preoperative assessment period the tooth to be extracted should be examined carefully to assess the difficulty of extraction.

Principles of Exodontia

- Access—The first factor to see is the adequacy of mouth opening. Any limitation of opening may compromise the ability to do routine extraction. The cause of limited mouth opening should be ruled out. Plane for surgical removal is done.
- Status of the supporting structures—The status of surrounding structure should be evaluated. Presence of any infection periodontal problems should rule out. Relation with adjacent vital structure and maxillary sinus is also determined.
- Status of tooth and crown—The assessment of crown of the tooth before extraction is always needed. The presence of large carious lesion, root canal filled tooth and large restoration should be checked. The presence of calculus the condition of adjacent tooth is also evaluated. One must check for the presence of mobility of teeth.

INTERPRETATION OF A PREOPERATIVE RADIOGRAPH

- Radiographic anatomy
- Condition of surrounding bone
- Assessment of adjacent vital structures
- Assessment of condition of adjacent teeth
- Assessment of tooth in question

As bone density increases, the amount of socket expansion obtained during forceps extraction becomes less and tooth removal thus requires more force.

The more dense the bone, the greater the risks for root fracture and/or fracture of alveolar bone.

Bone density may be interpreted radiographically by the relative amount of trabeculation. This is only possible by standardizing the radiographic procedure in your office. Assessment of radiograph is discussed in details in the subsequent chapter of exodontia.

PATIENT AND SURGEON PREPARATION

- The concept of universal precautions states that all patients must be viewed as having blood borne diseases that can be transmitted to the surgical team.

- Before extraction: Patients should vigorously rinse their mouths with an antiseptic mouth rinse such as chlorhexidine.

To prevent teeth or fragments of teeth from falling into the mouth and potentially being swallowed or aspirated into the lungs, it is preferable to place a 4 x 4 inch gauze loosely into the back of the mouth. However, it should not make the patient gag.

CHAIR POSITION FOR FORCEPS EXTRACTION

- Position of patient, operator and chair are critical for successful completion of the extraction. Best position is the one that is most comfortable for the operator and the patient.
- A proper chair position allows for maximal control over the force that is being delivered to the patient's tooth through the forceps.
- A correct position allows:
 - a. The surgeon to keep the arms close to the body
 - b. Provide support and stability
 - c. To keep the wrists straight enough to deliver the force with the arm and shoulder, and NOT with hand.

For a Maxillary Extraction

The chair should be tipped backward so that the maxillary plane is at 45° to the floor (Figure 5.1).

Height of the chair is such that the mouth is at or slightly below the operator's elbow level (Figure 5.2).

Howe: Site of operation is about 8 cm below the shoulder level of operator.

Archer: Occlusal plane is at 45° to 90°

- Maxillary right quadrant: The patient's head should be turned substantially toward the operator for adequate access and visualization (Figure 5.3).
- Maxillary left quadrant: Patient's head is turned slightly toward the operator (Figure 5.4).
- Maxillary anterior portion: Patient should be looking straight ahead (Figure 5.5).

Exodontia Practice

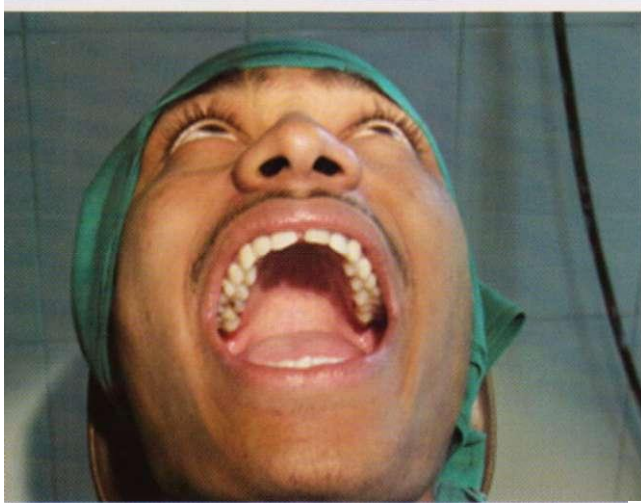


Figure 5.1: Maxillary occlusal plane at 45° to the floor



Figure 5.2: Position of patient's head on chair



Figure 5.3: Maxillary right quadrant tooth extraction



Figure 5.4: Maxillary left quadrant tooth extraction



Figure 5.5: Maxillary anterior tooth extraction

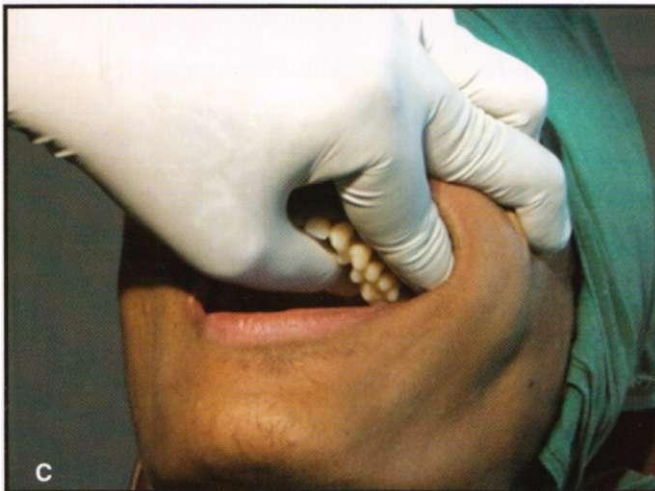
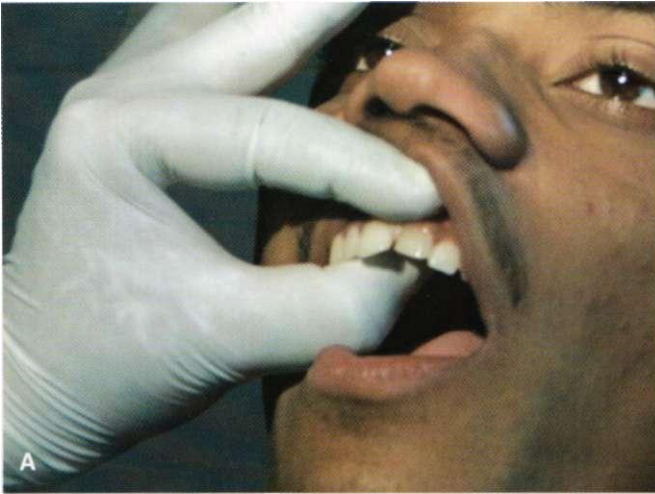
- **Placement of fingers during extraction**

- Maxillary teeth: For the left and anterior teeth, the left index finger of the surgeon should reflect the lip and cheek tissue, thumb should rest on the palatal alveolar process. For the right side, the index finger is positioned on the palate and thumb on the buccal aspect (Figures 5.6A to C).

For a Mandibular Extraction

Patient to be positioned in a more upright position so that the occlusal plane is parallel to the floor when the mouth is opened widely (Figure 5.7).

Principles of Exodontia



Figures 5.6A to C: Position of fingers during extraction of maxillary teeth

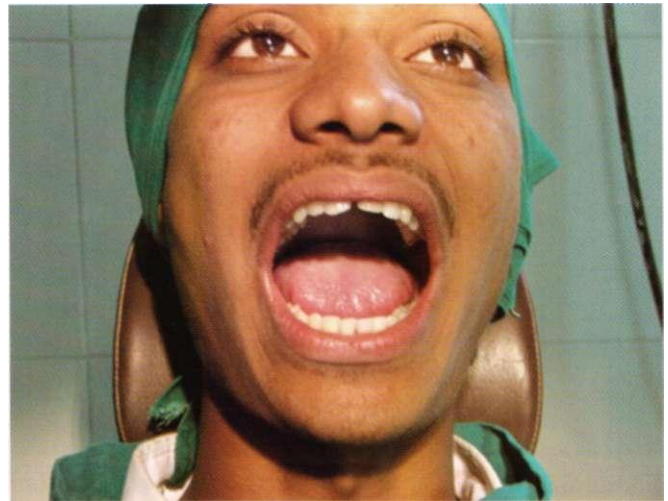


Figure 5.7: Mandibular occlusal plane parallel to floor

The chair should be lower than for extraction of maxillary teeth, and the surgeon's arm is inclined downward to approximately a 120° angle at the elbow (Figure 5.8).

- Mandibular right posterior teeth: Patient's head is turned toward the surgeon to allow adequate access to the jaw and the surgeon should maintain proper arm and hand position. Surgeon is usually at the side of the patient or at the back at 11° clock position (Figure 5.9).
- Mandibular anterior region: Surgeon is at the side or at the front of the patient at 8° clock position (Figure 5.10).

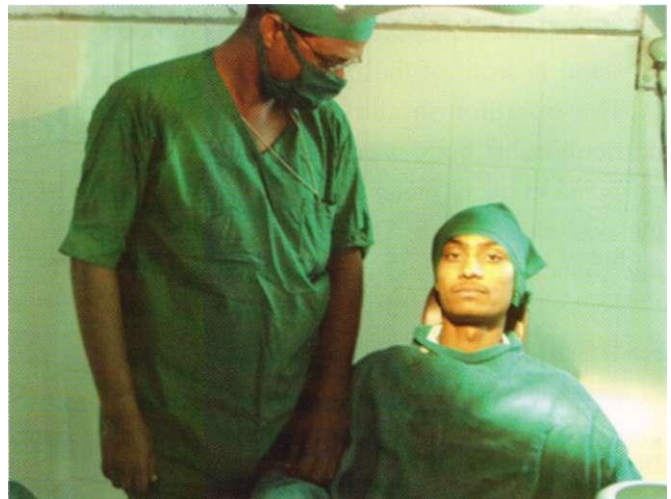


Figure 5.8: Patient's head position on chair

Exodontia Practice



Figure 5.9: Operator position for extraction of mandibular right posterior teeth



Figure 5.11: Extraction of teeth from mandibular left posterior region



Figure 5.10: Extraction of teeth from mandibular anterior region

- Mandibular left posterior region: Surgeon should stand in front of the patient (Figure 5.11).

The operator should stand with his feet apart, distributing his body weight equally.

Some surgeons prefer to approach the mandible from the posterior portion. The left hand then goes around the patient's head and supports the jaw.

PLACEMENT OF FINGERS DURING EXTRACTION OF MANDIBULAR TEETH

- For the left posterior and anterior teeth, the index finger of the left hand reflects the cheek and lips as it is placed in the buccal vestibule.

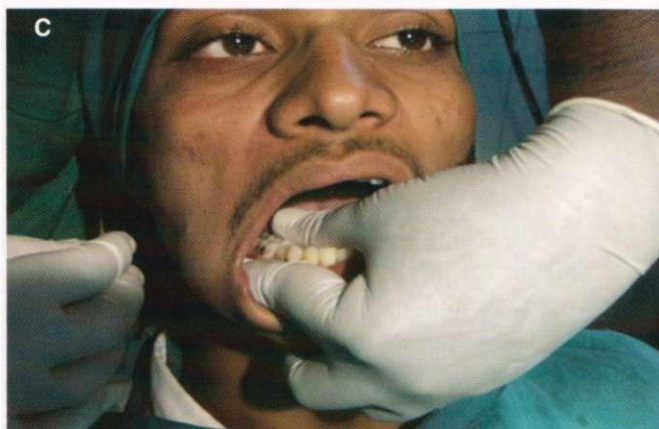
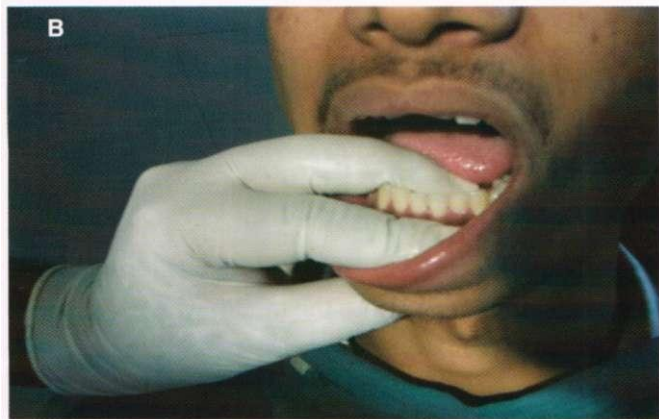
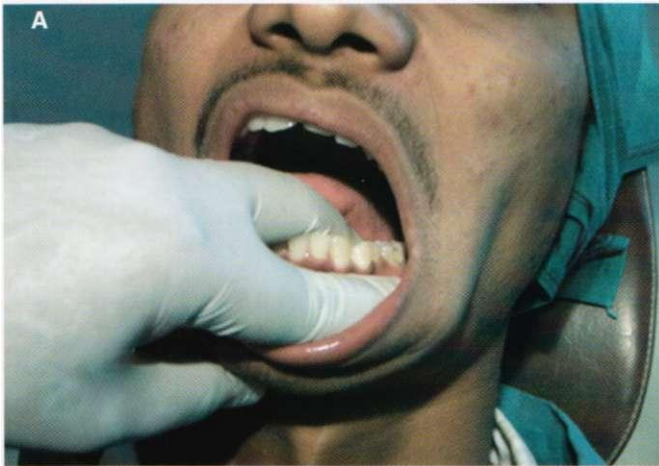
- The middle finger reflects the tongue as it is placed in the lingual vestibule.
- The thumb is placed below the chin so that the jaw is held between the fingers and the thumb.
- This technique provides less tactile information, but during extraction of mandibular teeth the need to support the mandible supersedes the need to support the alveolar process (Figures 5.12A to C). For mandibular right side, the thumb reflects the tongue, the index fingers reflects the lip and middle finger supports lower border of mandible.
- A useful alternative is to place a bite block between the teeth on the contralateral side. It allows the patient to provide stabilizing forces to limit the pressure on the TMJ. However, the surgeon's hand should continue to provide additional support.

ROLE OF OPPOSITE HAND

The opposite hand plays an active role in the procedure:

1. Reflecting soft tissues to provide adequate visualization of the area of surgery.
2. Protection of other teeth from the forceps.
3. Stabilization of the patient's head during extraction.
4. Most importantly it supports the alveolar process and provides tactile information to the operator concerning the expansion of the alveolar process during luxation.
5. Compress the socket after removal of the tooth.

Principles of Exodontia



Figures 5.12A to C: Placement of fingers during extraction of mandibular teeth. (A) left quadrant, (B) anterior quadrant, (C) right quadrant

ROLE OF ASSISTANT DURING THE EXTRACTION PROCEDURE

1. Helps the surgeon to get an unobstructed view and access to the surgical field.

2. Suction away blood, saliva, irrigating solutions used.
3. Support the mandible when required.
4. Provide psychologic and emotional support for the patient.

However, the assistant must not make casual and offhand comments that may increase patient's anxiety.

MECHANICAL PRINCIPLES OF ELEVATORS

The removal of teeth from the alveolar process employs the use of following mechanical principles and simple machines:

- a. Lever
- b. Wedge
- c. Wheel and axle

LEVER PRINCIPLE

The elevator is a lever of first class. The fulcrum lies between the effort arm and load arm. The lever principle has three components fulcrum, power and weight. While extracting a tooth controlled force is delivered in a predetermined direction. The power is represented by handle and the weight is represented by the beaks. Lever is a mechanism by which modest force is transmitted at long power arm so that the mechanical advantage is derived at the short weight arm. This principle is used when elevators are used for extraction.

WEDGE

It is an established physical principle that a wedge can be used to split, expand or displace the portion of substance that receives force. The wedge is a movable inclined plane which overcomes a large resistance applied at right angles to the applied effort. The effort is applied to the base of the plane and the resistance has its effect on the slant side.

The sharper the angle of the wedge, the less effort required to make it overcome a given resistance.

Exodontia Practice

- Wedge principle as applicable to extraction with forceps:
Beaks of extraction forceps are usually narrow at their tips. They usually broaden as they go superiorly.
The tips of the forceps are forced into the periodontal ligament space to expand the bone and force the tooth out of the socket.
- Wedge principle as applicable to the use of elevators:
A small apexo elevator displaces the root toward the occlusal plane and therefore out of the socket.
- Obvious debris such as tooth fragments, calculus, amalgam must be gently removed
- Expanded buccolingual plates should be compressed back to their original configuration.
- Sharp edges of bone to be smoothed with a bone file.
- To gain control over the hemorrhage, a moistened gauze to be kept over the socket so that it fits into the space previously occupied by the crown of the tooth.

WHEEL AND AXLE PRINCIPLE

It is a modified form of lever. The effort is applied to the circumference of the wheel which turns the axle so as to raise a weight.

It can be used as a sole work principle in removing teeth.

It can also be used in conjunction with the wedge principle and in some cases with the lever principle.

PRINCIPLES OF EXODONTIA

Forcep is the primary instrument used to remove a tooth from the alveolar process:

1. Expansion of bony socket, i.e. the forcep creates micro fracture in the alveolar process by the use of wedge shaped beaks and movement of the tooth itself with the forceps.
2. Lever principle—this works same as that for elevator.
3. Wedge principle—the tip of the forceps beak is narrower anteriorly and broadens posteriorly. When the tip is forced between the mucoperiosteum and tooth it causes expansion of bony socket so that the tooth displaced out of socket.

POSTEXTRACTION CARE

- Socket should be debrided only if necessary
- Careful curettage of periapical lesion if it is visible on a radiograph
- Bleeding—The gauze pack to be held firmly between the jaws for a full half hour to 45 minutes. After the operation bleeding in the form of oozing may continue beyond 24 hours in some individuals without need for alarm. Force full spitting and excessive physical activity tend to increase bleeding.
- Hygiene—Mouthwash to be avoided for 24 hours after surgery. Then rinse the mouth with warm saline and one tea spoon of salt. Do clean the teeth with your routine tooth brush. Food debris needs to be cleaned at the site of extraction.
- Swelling—Swelling and discoloration often follow any procedure in oral cavity. Application of ice cap to the face briefly and intermittently for first day only.
- Diet—For first 24 hours soft and cold diet is advisable. Then take diet as near to normal as possible. Chew on side opposite to that of surgery. Avoid food that is difficult to masticate.
- Pain—To avoid pain take prescribed medications by the dentist within 45 minutes of extraction. This will avoid the medication to take effect before the effect of anesthesia is worn off.
- To prevent stiffness and to stimulate circulation, jaw exercises may be done.
- If any reason you are alarmed or unduly concerned about the condition of your mouth please call your dentist.

INSTRUCTIONS TO PATIENTS

Chapter

Intra-alveolar Extraction (Simple Exodontia)



Extraction of teeth is the most commonly performed procedure in the dental office. This chapter aims the basic steps involved in the extraction of individual teeth.

Dental forceps are used to extract the majority of erupted teeth. These instruments enable the operator to grasp the root of the tooth and exert force directly to the root mass in order to displace it from the surrounding bone.

Extraction of teeth is a procedure that incorporates the principles of surgery as well as many principles from physics and mechanics. When these principles are applied correctly, a tooth can most likely be removed intact from the alveolar process without untoward sequel. This chapter presents the principles and mechanics of uncomplicated exodontia, i.e. closed method of extraction. In addition to a discussion of fundamental underlying principles there also is a detailed description of techniques for removal of specific tooth with specific instrument.

It should be always remembered that the removal of a tooth does not require a larger amount of force but rather can be accomplished with finesse and controlled force in such a manner that the tooth is gently lifted from alveolar process. During preoperative assessment if we feel that the degree of difficulty is high, a deliberated surgical approach and not an application of excessive force should be done. Excessive force may injure local tissues and destroy surrounding bone and tooth.

PROCEDURE FOR CLOSED EXTRACTION

An erupted tooth can be extracted in one of two major ways: closed or open. The closed technique is also known as the simple, or forcep technique. The open technique is also known as the surgical, or flap, technique. The closed technique is the most frequently used technique and is given primary consideration for almost every extraction. The open technique is used when there is reason to believe that excessive force is necessary to remove the tooth or when a substantial amount of the crown is missing and access to the root of the tooth

is difficult. The correct technique for any situation should lead to a atraumatic extraction; the wrong technique may result in an excessively traumatic extraction.

Whatever technique is chosen, the fundamental requirements for a good extraction remain the same:

1. Adequate access and visualization of the field of surgery,
2. An unimpeded pathway for the removal of the tooth, and
3. The use of controlled force to luxate and remove the tooth.

For the tooth to be removed from the bony socket, it is necessary to expand the alveolar bony walls to allow the tooth root an unimpeded pathway, and it is necessary to tear the periodontal ligament fibers that hold the tooth in the bony socket. The use of elevators and forceps as levers and wedges with steadily increasing force can accomplish these two objectives.

GENERAL STEPS

There are five general steps in the closed-extraction procedure.

Step 1: Loosening of Soft Tissue Attachment from the Tooth

The first step in removing a tooth by the closed-extraction technique is to loosen the soft tissue from around the tooth with a sharp instrument such as the moon's probe. The purpose of loosening the soft tissue from the tooth is two-fold. First, it allows surgeons to assure both themselves and the patient that profound anesthesia has been achieved. When this step has been performed, the dentist informs the patient that the surgery is about to begin and that the first step will be to push the soft tissue away from the tooth. A small amount of pressure is felt at this step, but there is no sensation of sharpness or discomfort. The surgeon then begins the soft tissue-loosening procedure, gently at first and then with increasing force (Figure 6.1).



Figure 6.1: Loosening of the soft tissue attachment from the tooth

The second reason that the soft tissue is loosened is to allow the tooth-extraction forceps to be positioned more apically without interference from or impingement on the soft tissue of the gingiva. As the soft tissue is loosened away from the tooth, it is slightly reflected, which thereby increases the width of the gingival sulcus and allows easy entrance of the beveled wedge tip of the forceps beaks.

If a straight elevator is to be used to luxate the tooth, the moon's probe is also used to reflect the tooth's adjacent gingival papilla where the straight elevator will be inserted, which allows the elevator to be placed directly onto alveolar bone without crushing or injuring the gingival papilla.

Step 2: Luxation of the Tooth with a Dental Elevator

The next step is to begin the luxation of the tooth with a dental elevator, usually the straight elevator. Expansion and dilation of the alveolar bone and tearing of the periodontal ligament require that the tooth be luxated in several different ways. The straight elevator is inserted perpendicular to the tooth into the interdental space after reflection of the interdental papilla. The elevator is then turned in such a way that the inferior portion of the blade rests on the alveolar bone and the superior or occlusal portion of blade is turned toward the tooth being

extracted. Strong, slow, forceful turning of the handle moves the tooth in a posterior direction, which results in some expansion of the alveolar bone and tearing of the periodontal ligament. If the tooth is intact and in contact with stable teeth anterior and posterior to it, the amount of movement achieved with the straight elevator will be minimal. The usefulness of this step is greater if there is no tooth posterior to the tooth being extracted or if it is broken down to an extent that the crowns do not inhibit movement of the tooth (Figure 6.2).

In certain situations the elevator can be turned in the opposite direction, and more vertical displacement of the tooth will be achieved, which can possibly result in complete removal of the tooth.

Luxation of teeth with a straight elevator should be performed with caution. Excessive forces can damage and even displace the teeth adjacent to those being extracted. It must be kept in mind that this is only the initial step and that the forceps are the major instrument for tooth luxation in most situations.

Step 3: Adaptation of the Forceps to the Tooth

After placing the left hand in position and thus obtaining a clear view of the tooth to be extracted, the forceps blade are applied to the buccal and lingual surface of the roots of the tooth.

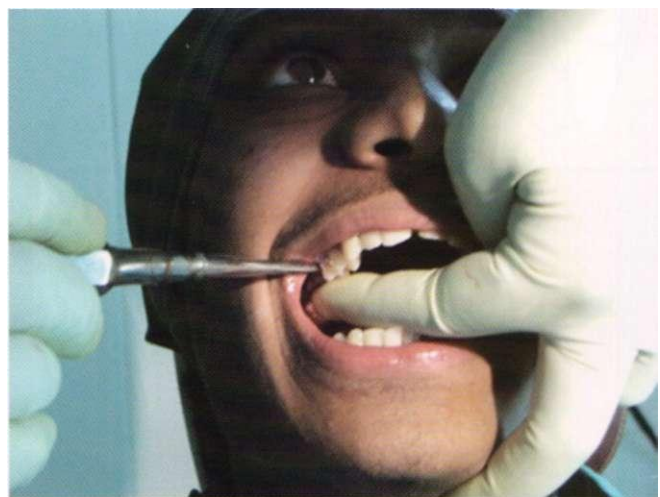


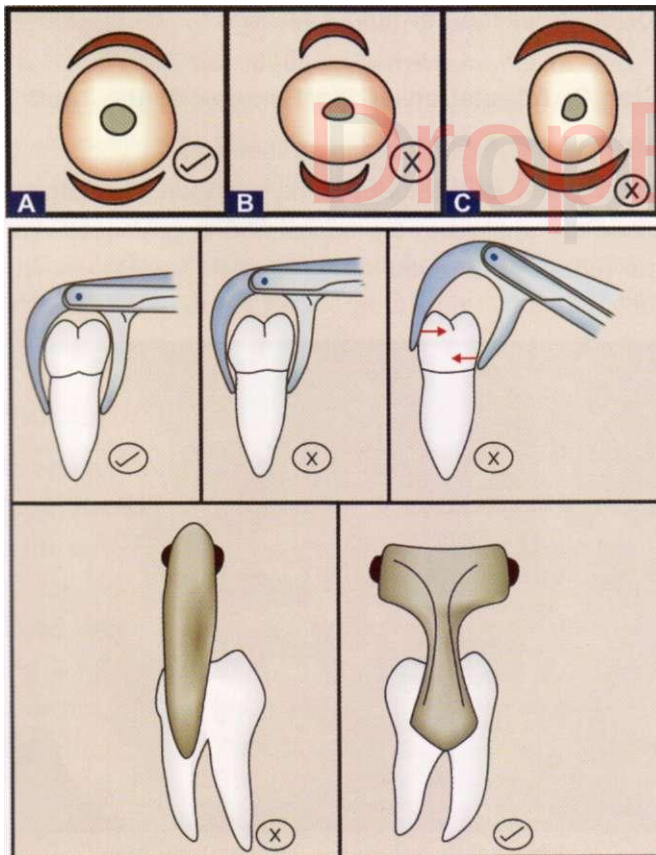
Figure 6.2: Application of dental elevator

The goals of forcep use are two-fold

1. Expansion of bony socket by use of the wedge shaped beaks of the forceps and the movement of the tooth itself with forceps.
2. Removal of the tooth from the socket.

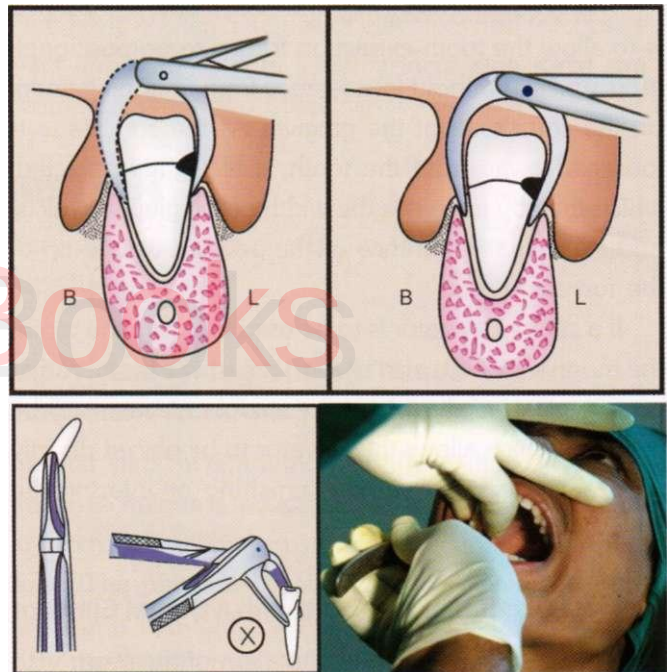
Certain rules must be observed in the application of forceps to the tooth.

- The correct forcep must be selected.
- Don't grasp the forcep near the beaks, instead hold them so that the ends of the handles are almost covered by the palm of the hands.
- The long axis of the forceps's beaks must be parallel to the long axis of the tooth (Figure 6.3).
- Forcep beaks must be placed on sound root structure and not on the enamel of the crown (Figure 6.4).
- The root structure must be grasped firmly so that when pressure is applied the beaks do not move on the cementum, otherwise breakage may occur (Figure 6.3)

**Figure 6.3:** Correct method of application of forcep to the tooth

- Make certain that beaks of the forceps will not impinge on adjacent teeth during the application of force.
- Beaks should not touch the crown when the roots are gripped (Figure 6.3).
- The root or root mass of the tooth is always gripped with the forceps (Figure 6.3).

It is a good practice to apply the forceps blade to the less accessible side to the tooth first under direct vision and then apply the other blade. If either the buccal or lingual surface of the tooth is destroyed by cervical caries, the appropriate blade should be applied to the carious side first, and the first movements made towards the carious side. This will allow the forceps blade to grip the sound tooth structure and reduce the risk of fracture of tooth (Figure 6.4).

**Figure 6.4:** Application of forcep to the tooth
(B—Buccal, L—Lingual)

The proper forceps are then chosen for the tooth to be extracted. The beaks of the forceps should be shaped to adapt anatomically to the tooth apical to the cervical line—that is, to the root surface. The forceps are then seated onto the tooth so that the tips of the forceps beaks grasp the root underneath the loosened soft tissue. The lingual beak is usually seated first and then the buccal beak. Care must be taken to confirm that the tips of the

forceps beaks are beneath the soft tissue and not engaging the adjacent tooth. Once the forceps have been positioned on the tooth, the surgeon grasps the handles of the forceps at the ends to maximize mechanical advantage and controlled force is applied.

If the tooth is malposed in such a fashion that the usual forceps cannot grasp the tooth without injury to adjacent teeth, another forceps should be employed. The maxillary root forceps can often be useful for crowded lower anterior teeth.

The beaks of the forceps must be held parallel to the long axis of the tooth, because the forces generated by the application of pressure to the forceps handle must be delivered along the long axis of the tooth for maximal effectiveness in dilating and expanding the alveolar bone. If the beaks are not parallel to the long axis of the tooth, there is increased likelihood of fracturing the tooth root (Figure 6.3).

The forceps are then forced apically as far as possible to grasp the root of the tooth as apically as possible. This accomplishes two things. First, the beaks of the forceps act as wedges to dilate the crestal bone on the buccal and lingual aspects. Second, by forcing the beaks apically the center of rotation (or fulcrum) of the forces applied to the tooth is displaced toward the apex of the tooth, which results in greater effectiveness of bone expansion and less likelihood of fracturing the apical end of the tooth.

At this point the surgeon's hand should be grasping the forceps firmly with the wrist locked and the arm held against the body; the surgeon should be prepared to apply force with the shoulder and upper arm without any wrist pressure. He or she should be standing straight with the feet comfortably apart.

Step 4: Application of Forces to the Tooth with the Forceps

Once the forcep is properly applied to the tooth certain forces are used to deliver tooth from its socket. They are apical force, labial or buccal force, lingual or palatal force, rotational force, and fractional force.

Apical force: As already explained beaks act as a wedges between the alveolar socket and tooth surface. Very little movement of the tooth in the apical direction takes place. Instead this movement expands the bony socket and helps in securing a firm grip over a larger area of the tooth. Teeth with single conical roots may jump out of the socket during this phase like an orange seed jumping off the two fingers when pressure is applied.

A second major accomplishment of apical pressure with the extraction forceps is that the fulcrum, the center of the tooth's rotation is placed more apically. Since the tooth is moving in response to the force placed on it by the forceps, the forcep becomes the instrument of expansion. If the fulcrum is high, there is a large amount of force on apical region of tooth, which increases the chance of root fracture. If the beaks of the forcep are forced a bit into the periodontal ligament space, the center of rotation is moved apically, which results in greater movement of forces at the crest of the ridge and less force moving the apex of the tooth. This process decreases the chance of apical root fracture (Figure 6.5).

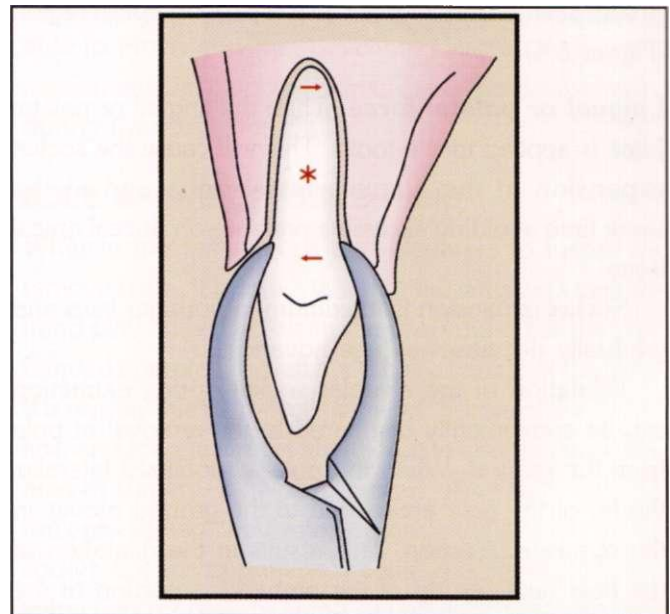


Figure 6.5: Apical force decrease the chance of apical root fracture

Exodontia Practice

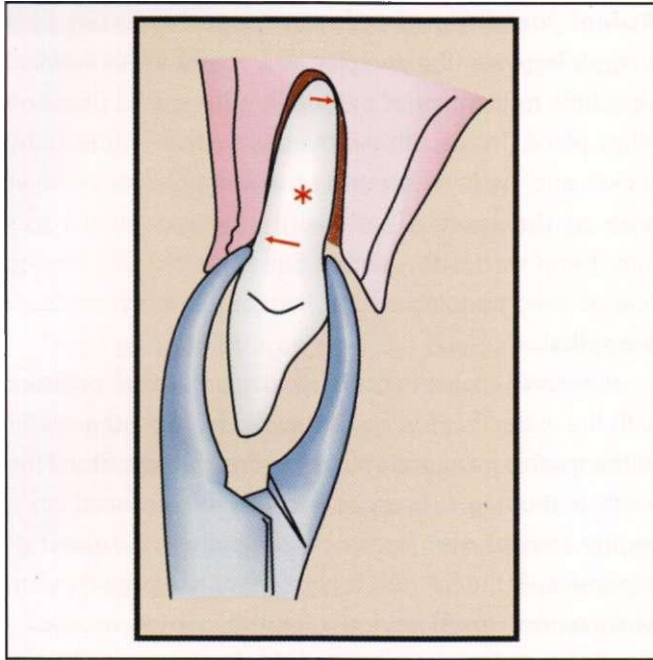


Figure 6.6: Buccal force application

Labial or buccal force: By keeping a continuous apical pressure buccal force is added which expands the bony socket still further. During this movement the forcep takes fulcrum from the crest of the alveolus. When buccal force is applied the expansion of buccal cortical plate occurs at crest and lingual cortical plate at apical region (Figure 6.6).

Lingual or palatal force: Then the lingual or palatal force is applied to the tooth. This will cause the socket expansion at the lingual crestal bone and at the same time avoiding excessive pressure on buccal apical bone.

Socket expansion is maximum in younger jaws and gradually decreases as age advances.

Dilatation of the alveolar socket during extraction can be conveniently compared to the removal of pole from the ground. When the pole is mobilized laterally, the tip of the pole embedded in the ground moves in the opposite direction. This results in the dilatation of the hole near the tip of the embedded portion of the pole. If the pole is moved in the opposite direction there will be dilatation in the opposite side (Figure 6.7).

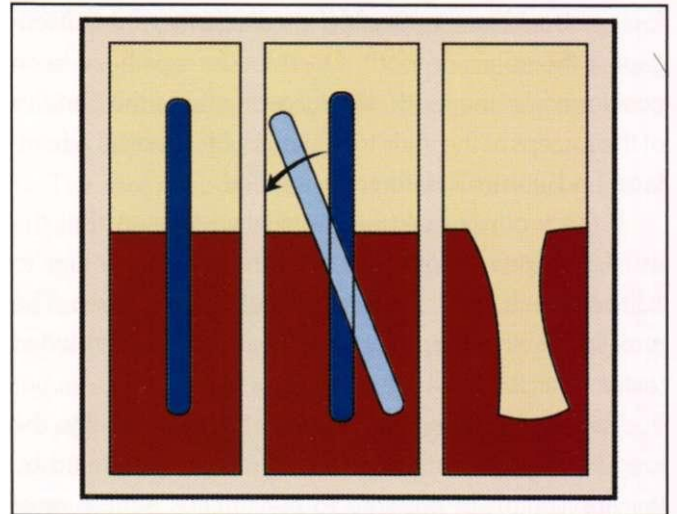
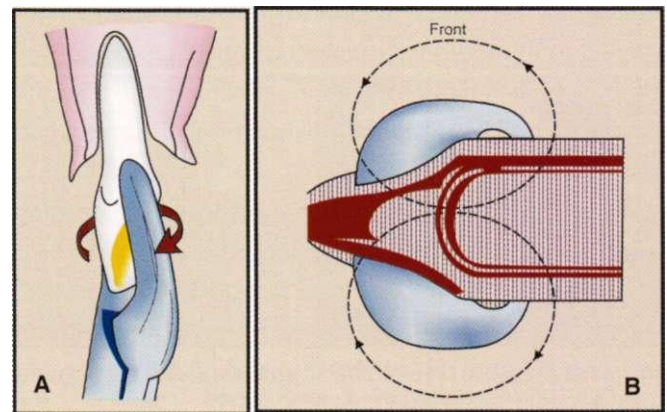


Figure 6.7: Principle of pole dilatation

Rotational forces: This is applied by using wheel and axle principle in the form of an arc with fulcrum of the lever principle on the crest to the buccal alveolus. This is the most important phase in the tooth extraction technique. Upper central incisor and lower second premolars can be removed by applying rotational forces along the long axis of root. Teeth that have multiple roots are more likely to fracture (Figure 6.8).



Figures 6.8A and B: (A) Application of rotational force.
(B) Figure of eight force

Tractional forces: This type of force is useful in the terminal phase of the tooth delivery out of the bony socket. Hence, this should be as gentle as possible (Figure 6.9).

The surgeon begins to luxate the tooth by using the motions discussed earlier. The major portion of the force

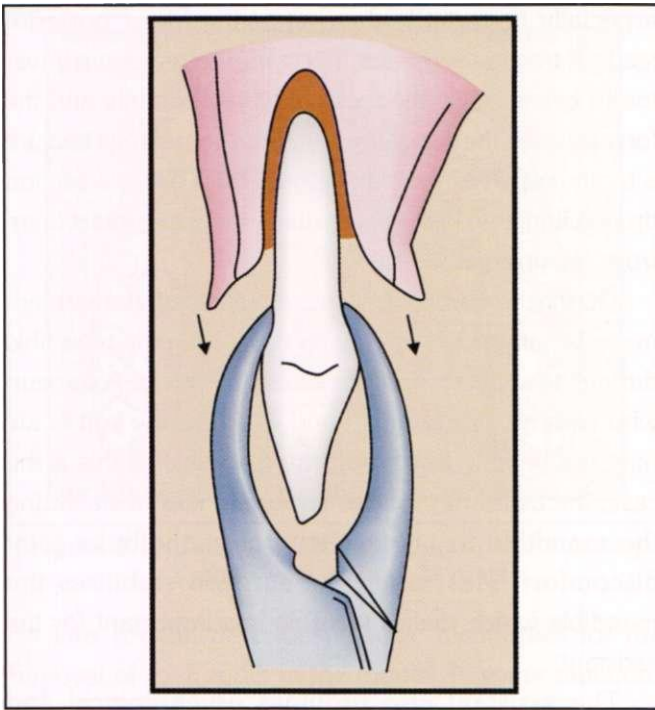


Figure 6.9: Tractional force

is directed toward the thinnest and therefore weakest bone. The surgeon uses slow, steady force to displace the tooth buccally. The motion is deliberate and slow and gradually increases in force. The tooth is moved again toward the opposite direction with slow, deliberate, strong pressure. As the alveolar bone begins to expand, the forceps are resealed apically with a strong deliberate motion, which causes additional expansion of the alveolar bone and further displaces the center of the rotation apically. Buccal and lingual pressures continue to expand the alveolar socket. For some teeth rotational motions are then used to help expand the tooth socket and the periodontal ligament attachment.

Beginning surgeons have a tendency to apply inadequate pressure for insufficient amounts of time. Three factors must be reemphasized: first, the forceps need to be seated apically as far as possible and resealed periodically during the extraction; second, the forces applied in the buccal and lingual directions should be slow, deliberate pressures and not jerky wiggles; and third, the force should be held for several seconds to allow the bone to expand. It must be remembered that teeth

are not pulled but rather gently lifted from the socket once the alveolar process has been sufficiently expanded.

Step 5: Removal of the Tooth from the Socket

Once the alveolar bone has expanded sufficiently and the tooth has been luxated, a slight tractional force, usually directed buccally, can be used. Tractional forces should be minimized, since this is the last motion that is used once the alveolar process is sufficiently expanded and the periodontal ligament completely severed.

It is useful to remember that luxation of the tooth with the forceps and removal of the tooth from the bone are separate steps in the extraction. Luxation is directed toward expansion of the bone and disruption of the periodontal ligament. The tooth is not removed from the bone until these two goals are accomplished. The surgeon should realize that the major role of the forceps is not to remove the tooth but rather to expand the bone so that the tooth can be removed.

For teeth that are malopposed or have unusual positions in the alveolar process, the luxation with the forceps and removal from the alveolar process will be in unusual directions. The surgeon must develop a sense for the direction the tooth wants to move and then be able to move it in that direction. Careful preoperative assessment and planning help to make this determination during the extraction.

ROLE OF THE OPPOSITE HAND

When using the forceps and elevators to luxate and remove teeth, it is important that the surgeon's opposite hand play an active role in the procedure. For the right-handed operator, the left hand has a variety of functions. It is responsible for reflecting the soft tissues of the cheeks, lips, and tongue to provide adequate visualization of the area of surgery. It helps to protect other teeth from the forceps, should they release suddenly from the tooth socket. It helps to stabilize the patient's head during the extraction process. In some situations large amounts of force are required to expand heavy alveolar bone, and therefore the patient's head requires active assistance in

being held steady. The opposite hand plays an important role in supporting and stabilizing the lower jaw when mandibular teeth are being extracted. It is often necessary to apply significant pressure to expand heavy mandibular bone, and such forces can cause discomfort and even injury to the temporomandibular joint unless they are counteracted by a steady hand. Finally, the opposite hand supports the alveolar process and provides tactile information to the operator concerning the expansion of the alveolar process during the luxation period. In some situations it is impossible for the opposite hand to perform all of these functions at the same time, so the surgeon requires an assistant to help with some of them.

ROLE OF ASSISTANT DURING EXTRACTION

For a successful outcome in any surgical procedure, it is essential to have a competent assistant. During the extraction the assistant plays a variety of important roles that contribute to making the surgical experience atraumatic to the patient.

The assistant helps the surgeon to visualize and gain access to the operative area. The assistant reflects the soft tissue of the cheeks and tongue so that the surgeon can have an unobstructed view of the surgical field. Even during a closed extraction the assistant can reflect the soft tissue so that the surgeon can apply the instruments to loosen the soft tissue attachment as well as adapt the forceps to the tooth and tooth root in the most effective manner.

Another major activity of the assistant is to suction away blood, saliva, and the irrigating solutions used during the surgical procedure. This prevents fluids from accumulating and makes proper visualization of the surgical field possible. Suctioning is also important for patient comfort, since most patients are unable to tolerate an accumulation of blood or other fluids in their mouths. During a surgical procedure it is almost impossible for the assistant to suction too much.

During the extraction the assistant should also help to protect the teeth of the opposite arch, which is

especially important when removing lower posterior teeth. If traction forces are necessary to remove a lower tooth, occasionally the tooth releases suddenly and the forceps strike the maxillary teeth and sometimes fracture a tooth cusp. The assistant should hold either a suction tip or a finger against the maxillary teeth to protect them from an unexpected blow.

During the extraction of mandibular teeth the assistant may play an important role by supporting the mandible during the application of the extraction forces. A surgeon who uses his or her own hand to reflect the soft tissue may not be able to support the mandible. If this is the case, the assistant plays an important role in stabilizing the mandible to prevent temporomandibular joint discomfort. Most often the surgeon stabilizes the mandible which makes this role less important for the assistant.

The assistant also provides psychological and emotional support for the patient by helping to alleviate patient anxiety.

DIRECTIONS TO MOVE TEETH FOR EXTRACTION

Exodontia is an art that must be learned and the operator gaining experience will begin to appreciate the feel of each tooth as it moves and so exploit the line of least resistance. There are however, several rules for each tooth based on the root form and the local bony anatomy of the alveolus.

MAXILLARY TEETH

Bone in the maxilla has a higher proportion of cancellous to cortical structure than the mandible and as a result is generally less dense than mandibular bone. The alveolar bone is thinner on its buccal or labial surface by comparison with the thicker palatal side. Therefore, the normal direction of tooth displacement is buccally. However, the buccal plate is buttressed in the first molar region by the zygomatic process of maxilla. The number and shape of roots affects the way in which a root is removed (Figure 6.10).

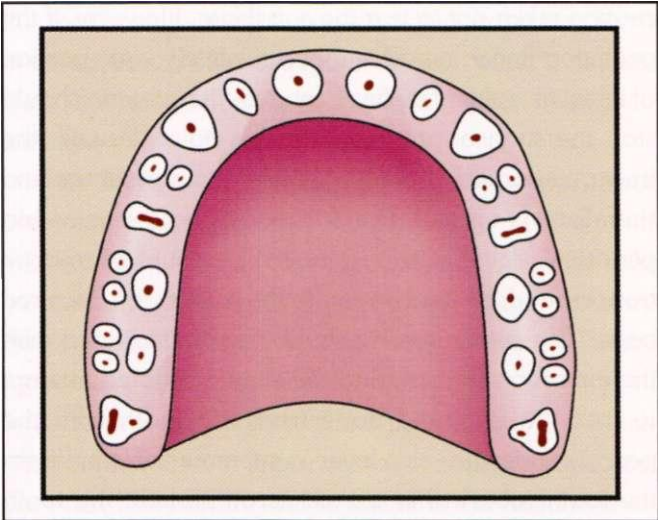


Figure 6.10: Diagrammatic representation of maxillary alveolus with number of roots

This section describes specific techniques for the removal of each tooth in the mouth. In some situations several teeth are grouped together—for example, the maxillary anterior teeth—since the technique for their removal is essentially the same.

MAXILLARY TEETH

In the correct position for extraction of maxillary left or anterior teeth, the left index finger of the surgeon should reflect the lip and cheek tissue, and the thumb should rest on the palatal alveolar process. In this way the left hand is able to reflect the soft tissue of the cheek, stabilize the patient's head, support the alveolar process, and provide tactile information to the surgeon regarding the progress of the extraction. When such a position is used during the extraction of a maxillary molar, the surgeon can frequently feel with the left hand, the palatal root of the molar becoming free in the alveolar process before realizing it with the forceps or extracting hand. For the right side, the index finger is positioned on the palate and the thumb on the buccal aspect.

Maxillary incisor teeth: The maxillary incisor teeth are extracted with the upper incisor forcep. The maxillary incisors generally have conical roots with the lateral ones

being slightly longer and more slender. The lateral incisor is more likely also to have a distal curvature on the apical one-third of the root, so this must be checked radiographically before extraction. The alveolar bone is thin on the labial side and heavier on the palatal side, which indicates that the major expansion of the alveolar process will be in the buccal direction. The initial movement is slow, steady, and firm in the labial direction, which expands the crestal buccal bone. A less vigorous palatal force is then used, followed by a slow, firm, rotational force. Rotational movement should be minimized for the lateral incisor especially if a curvature exists on the tooth. The tooth is delivered in the labial-incisal direction with a small amount of tractional force (Figure 6.11).

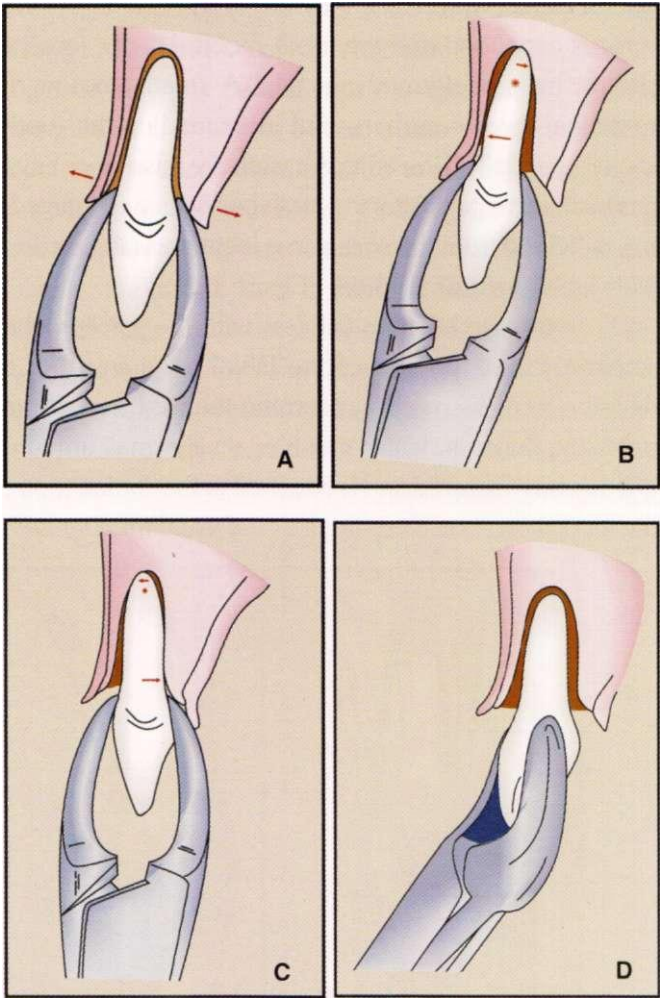


Figure 6.11: Extraction of maxillary central incisor

Maxillary Canine

The maxillary canine is usually the longest tooth in the mouth. The root is oblong in cross-section and usually produces a bulge on the anterior surface of the maxilla called the canine eminence. The result is that the bone over the labial aspect of the maxillary canine is usually quite thin. In spite of the thin labial bone, this tooth can be difficult to extract simply because of its long root. Additionally, it is not uncommon for a segment of labial alveolar bone to fracture from the labial plate and be removed with the tooth.

As with all extractions, the initial placement of the beaks of the forceps on the canine tooth should be as far apically as possible. The initial movement is to the buccal aspect with return pressure to the palatal. As the bone is expanded and the tooth mobilized, the forceps should be repositioned apically. A small amount of rotational force may be useful in expanding the tooth socket especially if the adjacent teeth are missing or have just been extracted. After the tooth has been well luxated, it is delivered from the socket in a labial-incisal direction with labial tractional forces (Figure 6.12).

If during the luxation process with the forceps, the surgeon feels a portion of the labial bone fracture, a decision must be made concerning the next step. If the palpating finger indicates that a relatively small amount of bone has fractured and is attached to the canine tooth, the extraction should continue in the usual manner with

caution-taken not to tear the soft tissue. However, if the palpating finger indicates that a relatively large portion of labial alveolar plate has fractured, the surgeon should stop the surgical procedure at this point. Usually the fractured portion of bone is attached to periosteum and therefore is viable. The surgeon should use a thin periosteal elevator to raise a small amount of mucosa from around the tooth down to the level of the fractured bone. The canine tooth should then be stabilized with the extraction forceps, and the surgeon should attempt to free the fractured bone from the tooth with the periosteal elevator as a lever to separate the bone from the tooth root. If this can be accomplished, the tooth can be removed and the bone left in place attached to the periosteum. Normal healing should occur. If the bone becomes detached from the periosteum during these attempts, it should be removed, because it is most likely non-vital and may actually prolong wound healing. This procedure can be used whenever alveolar bone is fractured during extraction.

Maxillary First Premolar

The maxillary first premolar is a single-rooted tooth in its first two thirds with a bifurcation into a buccal and lingual root usually occurring in the apical one-third to one half. These roots may be extremely thin and are subject to fracture especially in older patients in whom bone density is great and bone elasticity is small. Perhaps

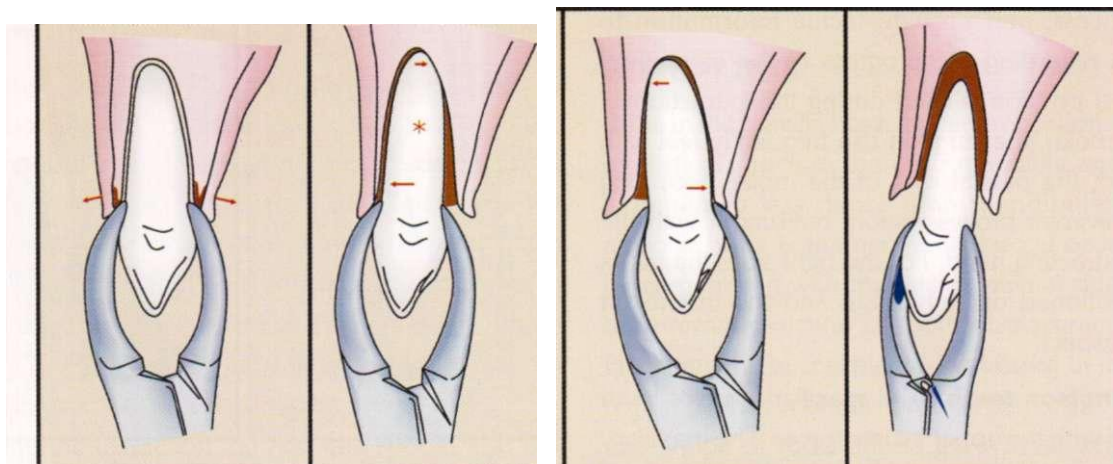


Figure 6.12: Extraction of maxillary canine

the most common root fracture when extracting teeth in adults occurs with this tooth. As with other maxillary teeth, the buccal bone is relatively thin when compared with the palatal bone.

The forceps of choice once again is the upper premolar forceps. Because of the bifurcation of the tooth into two relatively thin root tips, extraction forces should be carefully controlled during removal of the maxillary first premolar. Initial movements should be buccal. Palatal movements are made with relatively small amounts of force to prevent fracture of the palatal root tip, which is harder to retrieve. When the tooth is luxated buccally, the most likely tooth root to break is the labial. When the tooth is luxated in the palatal direction, the most likely root to break is the palatal root. Of the two root tips, the labial is easier to retrieve because of the thin, overlying bone. Therefore, buccal pressures should be greater than palatal pressures. Any rotational force should be avoided. Final delivery of the tooth from the tooth socket is with tractional force in the occlusal direction and slightly buccal (Figure 6.13).

Maxillary Second Premolar

The maxillary second premolar is a single-rooted tooth for the root's entire length. The root is thick and has

a blunt end. Consequently, the root of the second premolar fractures rarely. The overlying alveolar bone is similar to that of other maxillary teeth in that it is relatively thin toward the buccal with a heavy palatal alveolar palate.

The forceps are forced as far apically as possible so as to gain maximal mechanical advantage in removing this tooth. Since the tooth root is relatively strong and blunt, the extraction requires relatively strong movements to the buccal, back to the palate, and then in the buccal-occlusal direction with a rotational, tractional force (Figure 6.14).

Maxillary Molar

The maxillary first molar has three large and relatively strong roots. The buccal roots are usually relatively close together, and the palatal root diverges widely toward the palate. If the two buccal roots are also widely divergent, it becomes difficult to remove this tooth by closed, or forceps, extraction. Once again the overlying alveolar bone is similar to that of other teeth in the maxilla; the buccal plate is thin and the palatal cortical plate is thick and heavy. When evaluating this tooth radiographically, one should note the size, curvature, and apparent divergence of the three roots. Additionally,

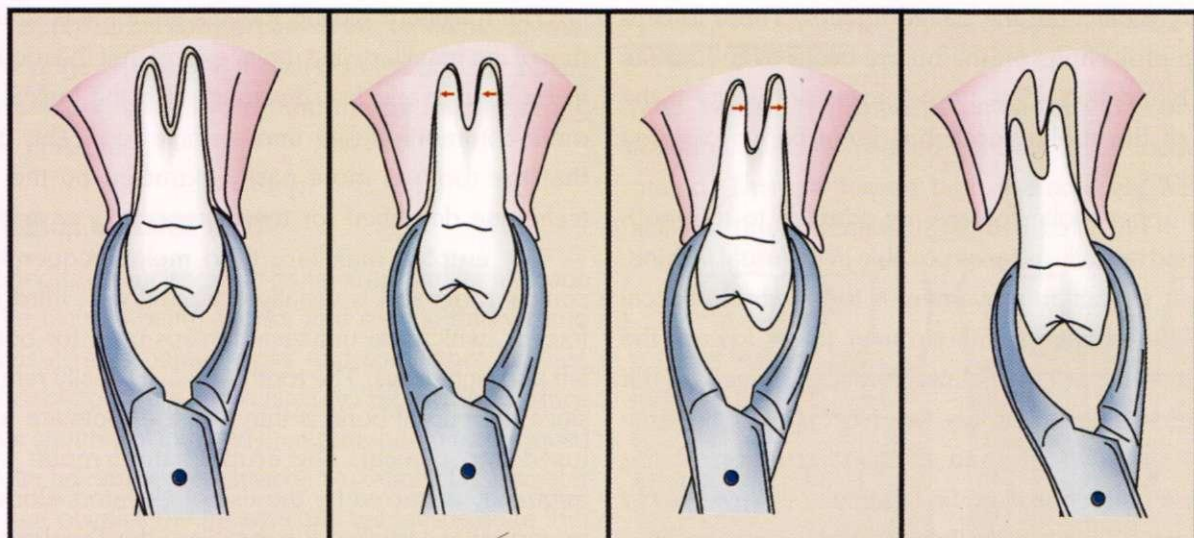


Figure 6.13: Extraction of maxillary first premolar

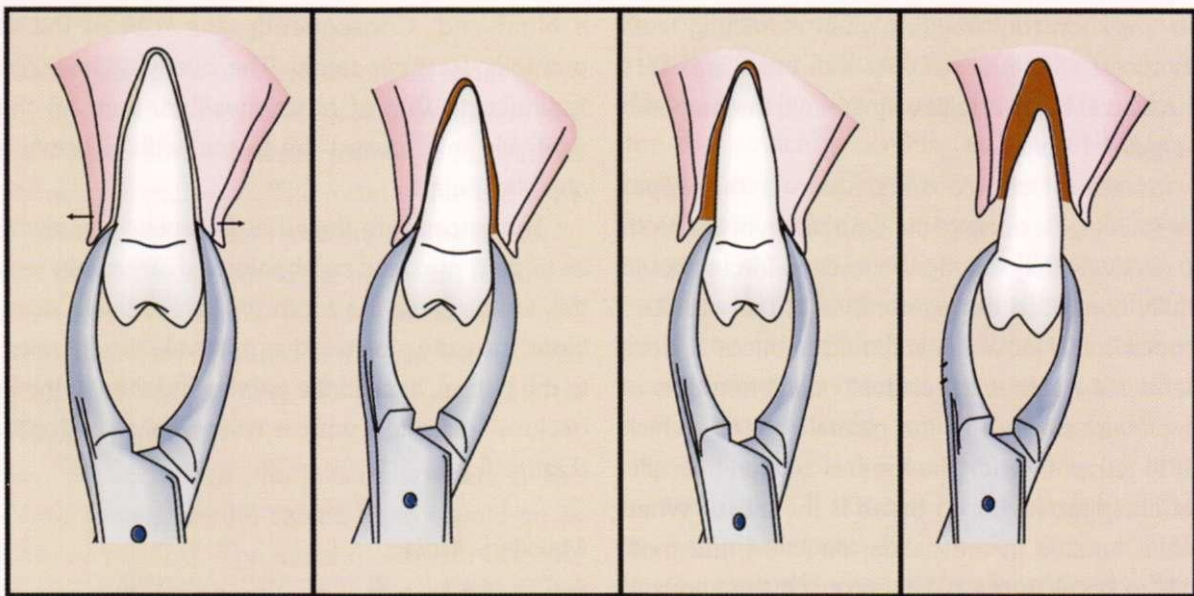


Figure 6.14: Extraction of maxillary second premolar

the dentist should look carefully at the relationship of the tooth roots to the maxillary sinus. If the sinus is in close proximity to the roots and the roots are widely divergent, there is increased likelihood of sinus perforation caused by removal of a portion of the sinus floor during tooth removal. If this appears to be likely after preoperative evaluation, the surgeon should strongly consider a surgical extraction.

The forceps usually used for extraction of the maxillary molars are the paired forceps. These forceps have tip projections on the buccal beaks to fit into the buccal bifurcation. Cow horn forceps are useful if the crown of the molar tooth has large caries or large restorations.

The upper molar forceps are adapted to the tooth and seated apically as far as possible in the usual fashion. The basic extraction movement is to use strong buccal and palatal pressures with stronger forces toward the buccal than toward the palate. Rotational forces are not useful for extraction of this tooth because of its three roots. As was mentioned in the discussion of the extraction of the maxillary first premolar, it is preferable to fracture a buccal root than a palatal root, because it is easier to retrieve the buccal roots. Therefore, if the

tooth has widely divergent roots and the dentist suspects that one root may be fractured, the tooth should be luxated in such a way as to prevent fracturing the palatal root. One must minimize palatal force, since this is the force that fractures the palatal root. Strong, slow, steady, buccal pressure expands the buccal cortical plate and tears the periodontal ligament fibers that hold the palatal root in its position. Palatal forces should be used but kept to a minimum (Figure 6.15).

The maxillary second molar's anatomy is similar to that of the maxillary first molar except that the roots tend to be shorter and less divergent with the buccal roots more commonly fused into a single root. This means that the tooth is more easily extracted by the same technique described for the first molar.

The erupted maxillary third molar frequently has conical roots and is usually extracted with third molar forceps, which are universal forceps used for both the left and right sides. The tooth is usually easily removed, since the buccal bone is thin and the roots are usually fused and conical. The erupted third molar is also frequently extracted by the use of elevators alone. It is important to visualize the maxillary third molar clearly on the preoperative radiograph, because the root

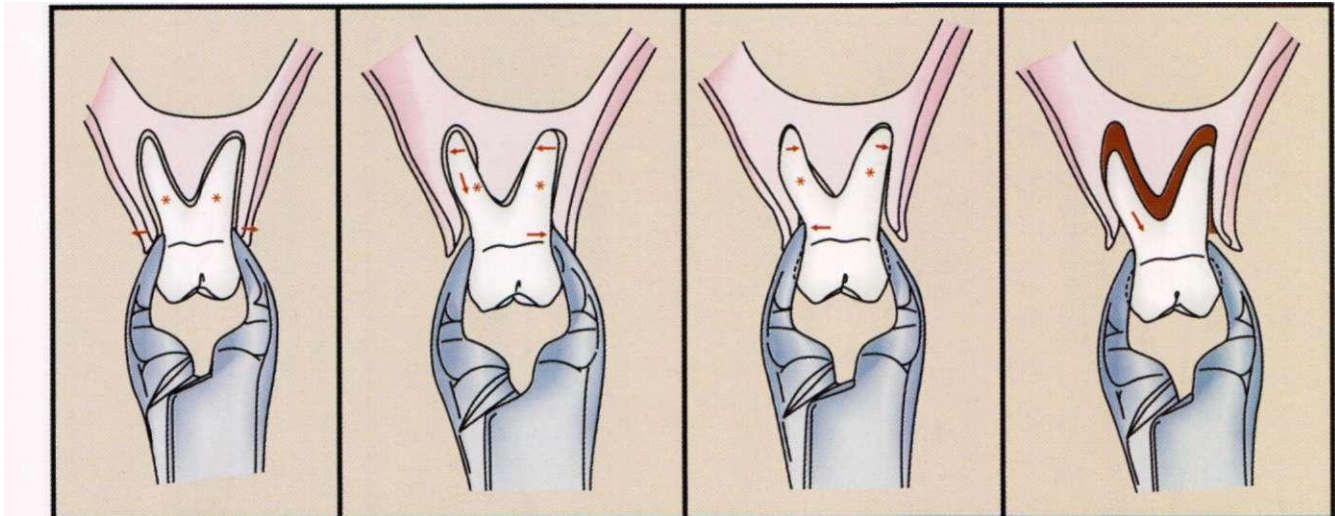


Figure 6.15: Extraction of maxillary molar

anatomy of this tooth is quite variable and often small, dilacerated, hooked roots exist in this area. Retrieval of fractured roots in this area can be very difficult.

MANDIBULAR TEETH

The mandible has a more ratio of cortical to cancellous bone than maxilla. Consequently the alveolar bone supporting lower teeth is more dense and less readily deformed. Making the displacement of mandibular teeth more difficult. Buccal and lingual cortices tend to be of similar thickness in the anterior mandible. Distally in molar region buccal cortical plate is thickened by external oblique ridge. Therefore, incisors canine and premolars requires strong buccal force and molars require strong lingual pressure.

MANDIBULAR ANTERIOR TEETH

The mandibular incisors and canines are similar in shape with the incisors being shorter and slightly thinner and the canine roots being longer and somewhat heavier. The incisor roots are more likely to be fractured, since they are somewhat thin and therefore should be removed only after adequate pre-extraction luxation. The alveolar bone that overlies the incisors and canines is quite thin on the labial as well as the lingual sides. The bone over

the canine may be somewhat thicker especially on the lingual side.

The usual forceps employed to remove these teeth is the lower anterior forceps. The forceps beaks are positioned onto the teeth and seated apically with strong force. The extraction movements are generally in the labial and lingual directions with equal pressures both ways. Once the tooth has become luxated and mobile, rotational movement may be used to expand the alveolar bone further. The tooth is removed from the socket with fractional forces in a labial-incisal direction (Figure 6.17).

STOBIE'S TECHNIQUE

If the extraction of multiple anterior teeth is indicated, straight elevator is inserted both the lower incisors and rotated. This will loosen both the adjacent teeth and facilitate the extraction (Figure 6.16).

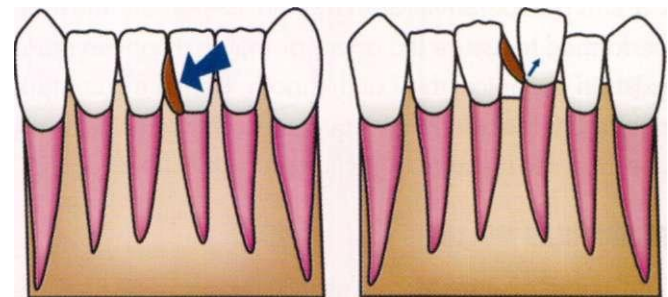


Figure 6.16: Stobie's technique for extraction of adjacent teeth

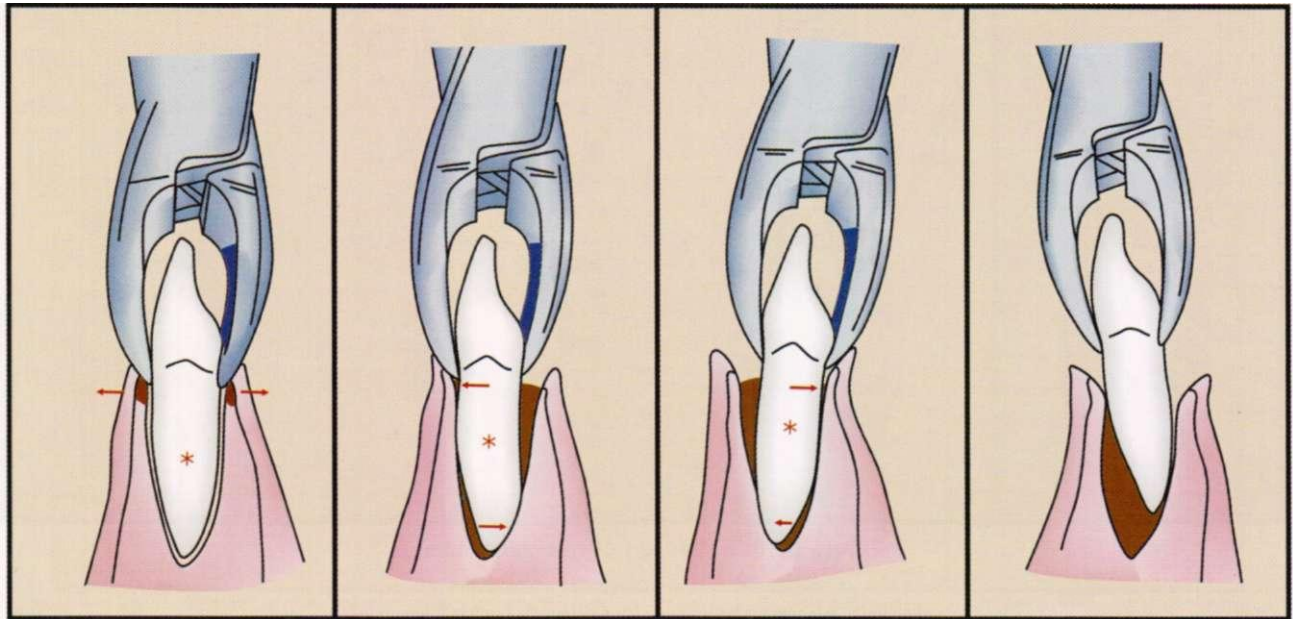


Figure 6.17: Extraction of mandibular anterior tooth

MANDIBULAR PREMOLARS

The mandibular premolars are among the easiest of all teeth to remove. The roots tend to be straight and conical, sometimes slender. The overlying alveolar bone is thin on the buccal aspect and somewhat heavier on the lingual side.

The forceps usually chosen for extraction of the mandibular premolars are the lower premolar forceps. The forceps are forced apically as far as possible with the basic movements being toward the buccal aspect, returning to the lingual aspect, and finally rotating. Rotational movement is used more when extracting these teeth than any others except the maxillary central incisor. The tooth is then delivered in the occlusal-buccal direction. Careful preoperative radiographic assessment must be performed to assure the operator that no root curvature exists in the apical third of the tooth. If such a curvature does exist, the rotational movements should be reduced or eliminated from the extraction procedure (Figure 6.18).

MANDIBULAR MOLARS

The mandibular molars are usually two-rooted with roots of the first molar more widely divergent than those of

the second molar. Additionally, the roots may converge at the apical one-third, which increases the difficulty of extraction. The roots are generally heavy and strong. The overlying alveolar bone is heavier than the bone on any other teeth in the mouth. The combination of relatively long, strong, divergent roots with heavy overlying buccal and lingual bone makes the mandibular first molar the most difficult of all teeth to extract.

The forceps usually used for extraction of the mandibular molars are mandibular forceps. The forceps are adapted to the root of the tooth in the usual fashion, and strong apical pressure is applied to set the beaks of the forceps apically as far as possible. Strong buccal and lingual motion is then used to expand the tooth socket and allow the tooth to be delivered in the buccal-occlusal direction. The lingual alveolar bone around the second molar is thinner than the buccal plate so the second molar can be more easily removed with stronger lingual than buccal pressures (Figure 6.19).

If the tooth roots are clearly bifurcated, the cow horn, forceps can be used. These forceps are designed to be closed forcefully with the handles, thereby squeezing the beaks of the forceps into the bifurcation. This creates

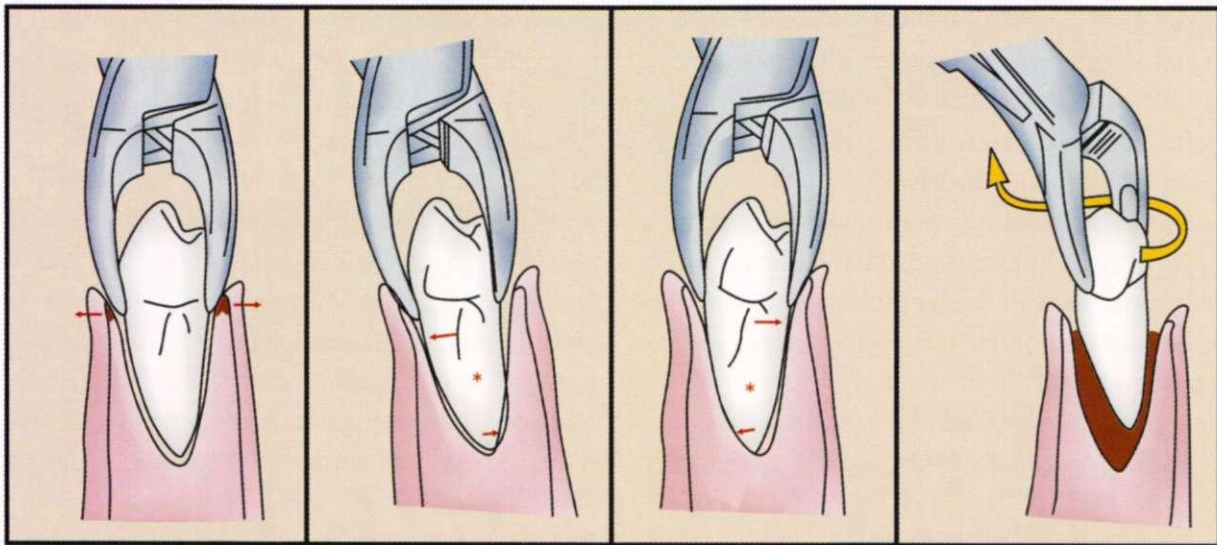


Figure 6.18: Extraction of mandibular premolar

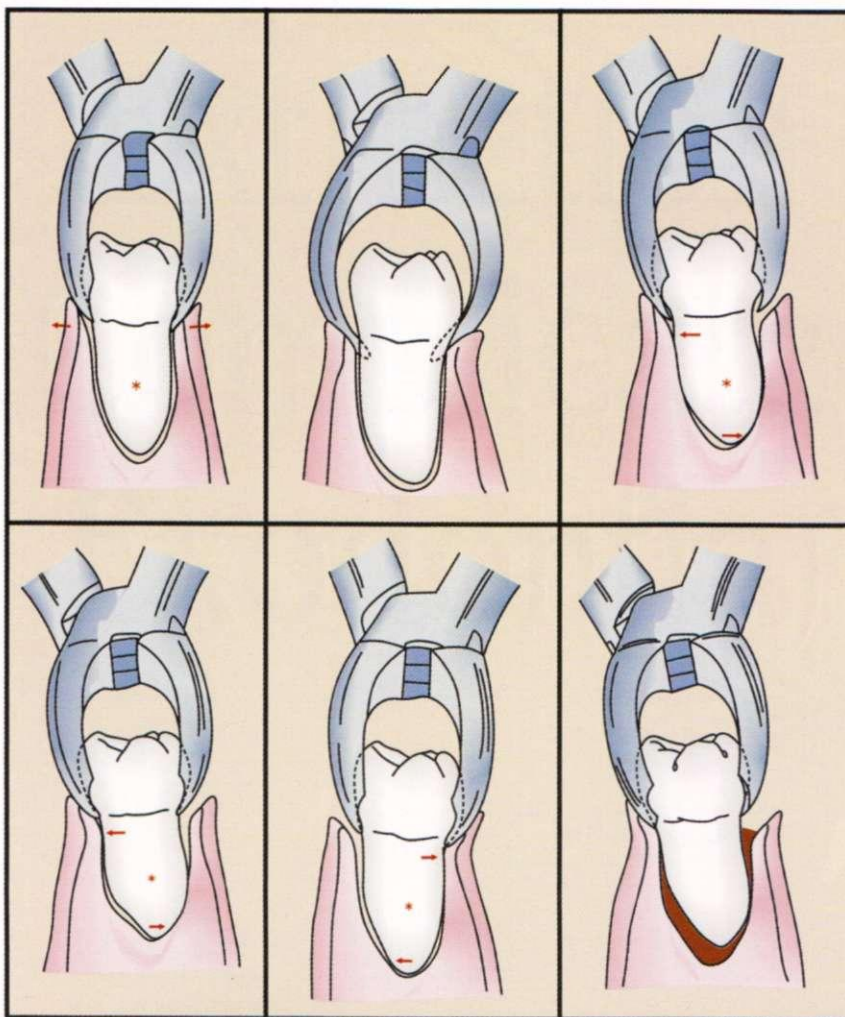


Figure 6.19: Extraction of mandibular molar

force against the crest of the alveolar ridge on the buccal and lingual aspects and literally forces the tooth superiorly directly out of the tooth socket. If initially this is not successful, the forceps are given buccal and lingual movements to expand the alveolar bone, and more squeezing of the handles is performed. Care must be taken with these forceps to prevent damaging the maxillary teeth, since the lower molar may actually pop out of the socket and thus release the forceps to strike the upper teeth.

Erupted mandibular third molars usually have fused conical roots. Since there is not usually a bifurcation,

the short-beaked, right-angled universal forceps is used for extraction. The lingual plate of bone is definitely thinner than the buccal cortical plate, so most of the extraction forces should be delivered to the lingual aspect. The third molar is delivered in the lingual-occlusal direction. The erupted mandibular third molar that is in function can be a deceptively difficult tooth to extract. The dentist should give serious consideration to using the straight elevator to achieve a moderate degree of luxation before applying the forceps. Pressure should be gradually increased, and attempts to mobilize the tooth should be made before final strong pressures are delivered.

Chapter

Transalveolar
Extraction
(Complicated
Exodontia)

7

Exodontia or tooth extraction is painless removal of a whole tooth or tooth-root, with minimal trauma to the investing tissues, so that the wound heals uneventfully and no postoperative prosthetic problem is created.

DEFINITION OF COMPLETE EXODONTIA

Complex extractions are defined as those extractions, not involving impaction, which cannot be removed by a simple application of elevators and forceps.

PETERSON

Complex extractions are retrieval of tooth root and teeth which are likely to fracture for some other reason and have an obstacle to extraction.

The surgical removal of tooth is the method used for recovering roots that were fractured during routine extraction or teeth that cannot be extracted by close method of extraction. This chapter discusses the technique for surgical removal of teeth, with different principles involved.

FACTORS THAT COMPLICATE THE EXTRACTION PROCEDURE

Factors that complicate the extraction procedure from simple to complicated extraction are as follows. These factors can be evaluated clinically and radiographically before going for extraction of any tooth.

1. Crown
2. Roots
3. Bone
4. Diminished access
5. Adjacent/non-adjacent teeth
6. Adjacent vital structures
7. Prosthetic concerns

CROWN

In cases where crown is destroyed by caries, complex restorations, fixed prosthesis, etc. the nature of the coronal portion of the tooth may prevent the application of instruments and therefore the application of forces.

Crowns may get crushed or shattered when gripped by the forceps (Figure 7.1). Teeth which have lost their crowns due to caries or fracture should be evaluated for necessity to undergo open extraction.

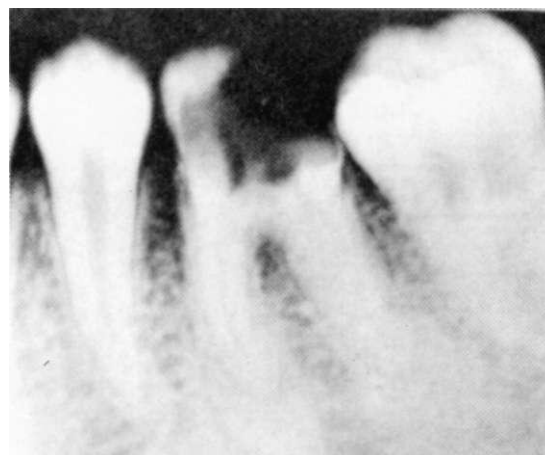


Figure 7.1: Badly carious tooth

ROOTS

All those roots that result in unfavorable path of removal or increased resistance are enumerated as under:

- a. Multiple roots
- b. Bulbous roots
- c. Root canal treated teeth
- d. Hypercementosis
- e. Ankylosed teeth
- f. Divergent roots
- g. Dilacerated roots

Multiple Roots

In teeth that have multiple roots individual roots may have different long axes. It is essential to apply the forces along the long axes of the tooth and hence it is necessary to remove each root along its long axis. Hence, there might be a need for transalveolar extraction of that tooth (Figure 7.2).

Bulbous Roots

In teeth that have bulbous roots there is mechanical obstruction to retrieval of the root. In spite of expansion of the socket there might not be enough space for delivery

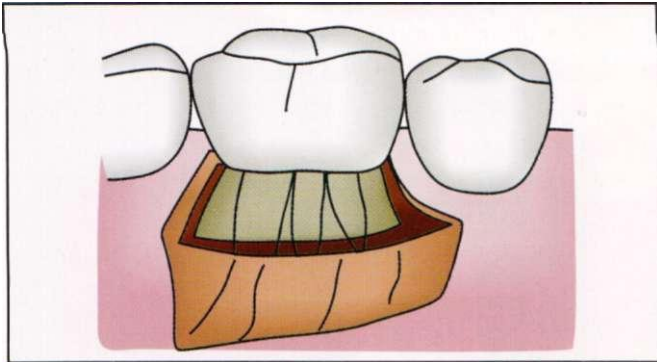


Figure 7.2: Multiple roots

of the root from the socket. Hence, such teeth should be considered for open extractions.

Root Canal Treatment

Teeth become brittle following root canal treatment mainly because of two reasons, viz. cutting of the tooth structure for endodontic treatment and because of dehydration of dentin following cessation of blood supply. The dentin becomes dessicated and hence, becomes brittle. Thus the tooth may crush during application of extraction forces due to either reduced bulk of the tooth or brittleness of the remaining tooth structure (Figure 7.3).



Figure 7.3: Root canal treated tooth

Hypercementosis

Hypercementosis occurs because of continuous deposition of cementum forming large bulbous roots especially in apical region. It occurs in chronic inflammation,

accelerated elongation of tooth, tooth repair and Paget's disease. It is difficult to remove the root in such cases through the available root socket because of smaller diameter of the socket at the cervical level. Due to difficulty in delivery of the root the operator might use increased forces which may cause root/bone fracture. Such roots require thorough radiographic evaluation and extractions by open technique (Figure 7.4).



Figure 7.4: Hypercementosis

Ankylosis

In this condition tooth is fused to alveolar bone. There is no intervening periodontal ligament. During extraction tooth is delivered from socket after severing of periodontal ligament. Hence, in ankylosed tooth delivery of tooth from socket is not possible. If excessive force is applied fracture of root or alveolar bone will occur. This condition is diagnosed using radiographs. On radiographic examination there is no periodontal ligament seen surrounding the root and there is bony union of tooth. On clinical examination dull tone is heard when tooth is percussed and no mobility can be felt when luxation of the root is attempted (Figure 7.5).

Exodontia Practice



Figure 7.5: Ankylosed tooth

Divergent Root

It occurs in some multirooted teeth; especially maxillary molars. Due to non-parallelism of long axes of the roots there is increased difficulty to extract tooth in one piece. Hence, transalveolar extraction needs to be carried out to extract the tooth uneventfully (Figure 7.6).



Figure 7.6: Divergent root

Dilacerated Roots

In dilacerated roots there is hooking of root to alveolar bone. Hence, there is an increased resistance to delivery of tooth while normal extraction forces are applied and it is difficult to deliver the tooth from the socket without fracture of the root at the point of hooking (Figure 7.7).

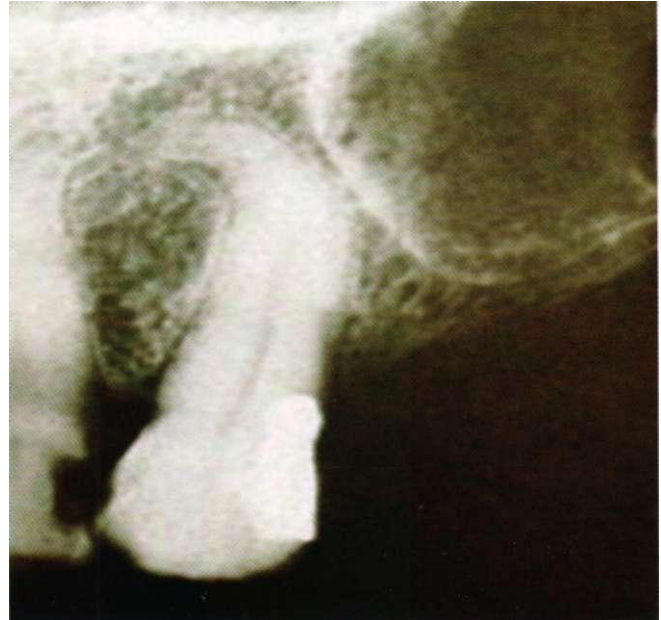


Figure 7.7: Dilacerated roots

BONE

The points to be considered are as follows:

- Periodontal health
- Increased bone density
- Increased bone bulk

Periodontal Health

The periodontal health determines firmness of tooth and hence, difficulty of extraction. In case the periodontal health is weak, the tooth will be mobile and hence, will be easily delivered from the socket. Conversely, in case of teeth with good periodontal health more is the difficulty while extracting the teeth. In cases such as long standing tooth, para-functional habits like bruxism, clenching there is an increase in the width of periodontal ligament. Hence, it becomes difficult to shear the periodontal ligament from bone and tooth, and the delivery of the tooth becomes difficult.

Increased Bone Density

In cases of bruxism and localized osteitis there is a significant increase in bone density chiefly on buccal cortical plate. The extraction depends chiefly on expansion of buccal

cortical plate. In cases of increased bone density expansion of socket is difficult and hence, there is difficulty in extraction of the tooth. This necessitates use of transalveolar method of extraction (Figure 7.8).



Figure 7.8: Increased bone density around the tooth

Increased Bulk

Increase in bulk of bone occurs due to presence of bony exostosis on the buccal or lingual cortical plate. This increases the difficulty in socket expansion and therefore extraction of the concerned tooth.

DIMINISHED ACCESS

Diminished access results chiefly from trismus resulting from infection of sub-masseteric space, oral submucous fibrosis, scleroderma. In case of sub-masseteric space infection trismus is the hallmark due to inflammation and spasm of Masseter muscle. Scleroderma or systemic sclerosis is a condition wherein there is progressive fibrosis of skin and various organs of the body. Oral manifestations are that lips become thin, firm and partially fixed leading to microstomia. Gingiva becomes firm. The reduced mouth opening is due to involvement of temporomandibular joint tissues. This makes dental care difficult. Due to decreased oral opening, application of instruments along long axes of teeth is difficult and sometimes impossible. This results in inability to apply

correct forces. Difficulty is much more in posterior teeth than anterior.

ADJACENT TEETH

In case of highly carious, heavily restored, endodontically treated adjacent teeth there are chances of fracture of the teeth due to either wrong application of elevator force or transmitted force. In case of periodontally compromised teeth there are chances of inadvertent extraction of the adjacent tooth causing grievous injury due to wrong application of force or transmitted forces. A long maxillary molar or canine has dense bone surrounding it with strong periodontal attachment due to the increased functional load that it bears. This causes difficulty in socket expansion and extraction. In case of maxillary molar, the maxillary sinus may have expanded to include roots of the molar. Extraction may result in removal of part of sinus floor and formation of oroantral communication. In divergent roots these chances increase.

PROXIMITY TO VITAL STRUCTURES

The vital structures that could be in close proximity to the teeth are inferior alveolar bundle, lingual nerve, maxillary sinus. In case of inferior alveolar nerve, risk of nerve injury during extraction of mandibular third molar is mainly during elevation of a mesioangular tooth. If the nerve is close to the apices of the tooth it might come in the arc of rotation and get compressed causing neuropraxia. In case of lingual nerve, due to its supra-periosteal course close to the 3rd molar, there are chances of damage during raising of mucoperiosteal flap. In addition, in cases of difficult extraction, due to trauma to the surrounding soft tissue during the extraction, the lingual nerve might get damaged. The maxillary sinus when close to the apices of maxillary molars carries the risk of formation of an oro-antral communication. Hence, when tooth is in close proximity to the vital structures, it is essential to consider open extractions (Figure 7.9).

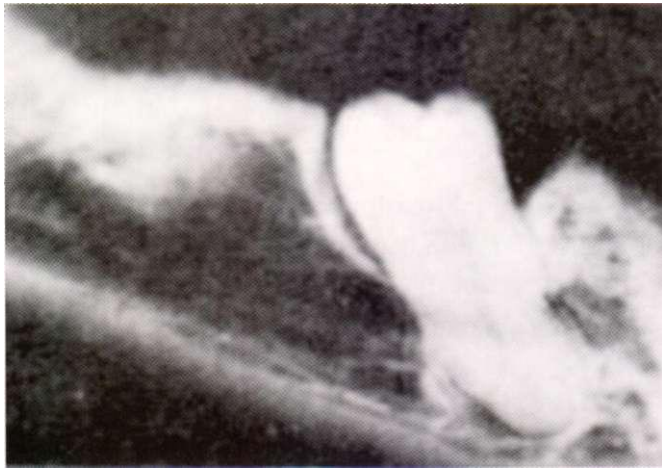


Figure 7.9: Tooth in close proximity to inferior alveolar nerve

PROSTHETIC CONCERNS

These include preservation of alveolus. When intra-alveolar extraction will cause more bone loss than transalveolar extraction, it is more prudent to opt for open extraction rather than try to perform a closed extraction. The next concern is maintaining correct alveolar contour. In case there is an existing bony undercut due to proclination of teeth, and an alveoloplasty is essential before prosthetic rehabilitation can be done, then performing an open extraction and performing an alveoloplasty at the same time is advisable. The third concern is preservation of attached gingiva of the adjacent teeth which might get damaged due to excessive trauma to the surrounding soft tissues due to overzealous attempt to perform a difficult extraction and will lead to loss of attached gingiva, pocket formation.

Once all these parameters are evaluated the following technical observations are taken in to consideration:

1. Basic steps such as severing periodontal ligament, expanding alveolus, and applying traction don't work.
2. Correct application of forceps not possible or in spite of correct application of forceps correct delivery of forces not possible.
3. Need to alter ability to apply the correct force and achieve the treatment objective

Following are the technical goals to be achieved at the time of complicated exodontia:

1. To improve the mechanical advantage
2. To reduce resistance
3. To correct an inadequate path of withdrawal.
1. *Improved access:* This is done by raising a mucoperiosteal flap and adequate bone removal
2. *Improved mechanical advantage:* This is achieved by bone removal and preparation of purchase point.
3. *Reduce resistance:* This is achieved by removal of bone support and sectioning of teeth (Odontectomy)
4. *Correct path of removal:* This is achieved by removal of bone and sectioning of teeth.

Following are the principles involved during the surgical removal of teeth:

1. Flap design
2. Bone removal
3. Sectioning teeth
4. Wound closure.

PRINCIPLES OF FLAP DESIGN

INCISION

A gingival margin incision which divides the mandibular interdental papillae will permit the insertion of a periosteal elevator and the reflection of either the buccal or lingual mucoperiosteum or both. If necessary, the papillae can be divided from one side molar around to the other without the operator encountering any sizeable vessel. Similarly, an incision along the crest of the mandibular edentulous ridge will also permit buccal and lingual mucoperiosteal flaps to be raised. Such flaps are described as envelope flaps.

If required the incision can be extended backwards into the retromolar region and then distobuccally up the external oblique ridge and anterior border of the coronoid process. No vessel of a size requiring formal ligation will be encountered until this upwards extension of the incision reaches a point just below the level of the occlusal surface of the upper 3rd molar. Here the buccal artery and long buccal nerve lie side by side and cross the

anterior border of the coronoid from medial to lateral on the superficial aspect of the buccinator muscle. The deep facial vein runs either with the artery and nerve or a little higher up.

By dividing the interdental papillae or by incising along the edentulous ridge, depending upon whether teeth are present or not. And then raising flaps, the outer and palatal aspects of the maxillary alveolar process can be exposed in a similar fashion. Again no sizeable vessel will be cut while making these incisions.

A second incision can be added which starts at one end of the crestal incision and is carried towards the buccal sulcus. The second incision can be a straight one which leaves the first at an obtuse angle, or with the edentulous ridge the crestal incision can be continued in a curve onto the buccal aspect of the alveolar process. In the dentulous patient the oblique relieving incision should include an interdental papilla at the corner to locate the flap on replacement. This two-sided, or triangular, flap is easy to retract and allows sufficient access for many small dentoalveolar procedures to be carried out, and is easy to suture. The addition of a second buccal incision at the other end of the crestal incision so creating a three sided quadrangular flap increases still further the degree of surgical access. By curving the sulcus ends of the incisions along the bottom of the sulcus in a direction away from the center of the flap the length of these relaxing incisions can be increased. This permits the reflection of the tissues to a higher level in the case of the maxilla or a lower one in the case of the mandible.

It is a basic principle of flap design that the base of the flap should be as wide as is practical to ensure a good blood supply. However, where teeth are standing, the angle at the gingival margin should be no more than around 100° or a narrow V shaped strip will be left which will have an inadequate blood supply at its tip.

In order to raise the flap along the gingival margin of the teeth the papillae needs to be divided interdentally. A No. 15 scalpel blade on a No. 3 handle is held parallel to the long axis of the teeth with the

back of the blade interproximally and the cutting tip used to incise vertically downwards, first the distal attachment of the papilla then the mesial attachment so dividing it like a wedge of cake. The blade may then be passed along the gingival crevice to divide the next papilla, but if this is done it should not cut the periodontal fibers below the alveolar crest. Often as the flap is reflected it will separate readily from the alveolar bone and the neck of the tooth so that the connecting incisions are not essential. In the edentulous jaw, however, the attachment of the mucoperiosteum to the crest of the ridge is particularly strong and not only the crestal incision be made firmly down to bone but reflection of the flap may need the assistance of the knife to cut the tough fibrous connections and to free it from the adjacent bone. The use of excessive force with a periosteal elevator may tear the flap, either at this narrow zone of strong attachment, or at the sulcus end of a two limbed incision.

It is important to design the incision so that a complete interdental papilla is present at each end of a three-sided flap, because this facilitates suturing through each interdental space. Bringing together the buccal and lingual papillae in this way produces excellent healing without clinically detectable increase in the depth of the gingival crevices. If such an incision is made in the experimental animal and the healing studied, a small down growth of epithelium will be found at the depth of the gingival crevice. The extent is microscopic, and not detectable clinically.

Recommendations have been made from time to time that the marginal gingiva should be avoided when outlining a flap, in order to prevent injury to epithelial attachment. Those who follow this advice make a horizontal incision 2-3 millimeters away from, and parallel to, the gingival margin. Unfortunately the strip of gingiva which is left covers the margin of the alveolar bone. Should the excision of bone be carried too close to the concealed socket margin while, for example, removing an unerupted upper canine, the crestal alveolar bone may be damaged. Loss of the marginal bone will not be repaired and permanent damage to

the tooth attachment will result. Retention of such a strip of gum also reduces surgical access with the result that it becomes traumatized both during the operation and when suturing, so producing necrosis with breakdown of the suture line. In addition, at the end of the operation, a bone cavity, such as the socket of a tooth or a cyst cavity, may lie close to the line of closure so that the wound edges are not adequately supported. Again the suture line will tend to break down and the flap fall into the underlying bony defect.

In general incision lines should be planned so that at the end of the operative procedure there is still an untouched zone of bone at the cavity margin to support the edge of the flap that has been reflected. This will provide a broad area of contact through which the process of healing can reattach the wound margin and develop an adequate degree of early wound strength to resist any tension during movement of the face and jaws in the period immediately after the removal of the sutures.

Mucoperiosteal flaps are relatively thin and do not possess layers which can be closed separately, of necessity any surgically created bone cavity forms a dead space and creates a hematoma. It is important to seal this effectively from the mouth and the possible ingress of infection. Failure to achieve primary wound healing for this or other reasons leads to exposure of the underlying clot, leaving a cavity which will be repaired slowly by 'secondary intention'.

As alveolar wounds cannot be closed in layers a valve-like closure is the best that can be achieved. Situating the incision so that there is a zone of intact bone between the cavity margin and the line of the soft tissue wound provides for such a valve-like closure. Where unavoidably the incision line crosses the cavity, eversion of the wound edge by mattress sutures creates an additional zone of tissue contact, but not as secure a closure as one supported on bone.

Provided incisions are confined to the mucoperiosteum of the alveolar process or the palate, that is the masticatory mucosa, the sutured wound is subject to

little tension. The sulcus tissues in contrast are elastic and the wound edges contract away from one another, though normally not so as to create a significant tension in the sutured wound. Incisions made in the sulcus radially or at right angles to the outer aspect of the jaw are not subject to muscular pull and are readily closed with little risk of wound dehiscence during healing. On the other hand, horizontally aligned incisions in the sulcus in some parts of the mouth are subject to tension during movements of the jaws, lips and cheeks and are best avoided. If such an incision is necessary, special care is required in its closure to avoid wound breakdown.

For example, the design of flap often used when an apicectomy is performed upon an anterior tooth is a semilunar one with the convexity towards the gingival margin. The incision for such a flap should not approach closer to the gingival margin than one third of the depth of the sulcus. Such a flap suffers from all of the disadvantages mentioned above. If the incision approaches closer to the gingival margin, the remaining strip of gum may slough, because its blood supply may be inadequate, particularly after sutures have been passed through it. Furthermore, it is not always easy to predict how large the surgical cavity may be at the end of the operation, particularly if a small cyst is to be dealt with during the apicectomy, and the flap may be inadequately supported at its margin. Finally the suture line will be under tension. This can be seen as soon as the sutures are inserted because the wound edges will gape between the sutures. Some operators attempt to overcome this problem by using horizontal mattress sutures, but there is a danger with such a small wound that they will be drawn too tight and strangulate the wound margin, particularly on the gingival side. A three-sided flap which includes the gingival margin of the tooth to be operated upon and its interdental papillae is more satisfactory.

The problem of tension from muscular activity is encountered again when horizontal incisions are made either to 'deglove' the chin or to expose the anterior part of the maxilla during a Le Fort I level osteotomy. Such incisions should be made so that a generous skirt of

Transalveolar Extraction (Complicated Exodontia)

sulcus mucosa is left on the gingival aspect. In the case of the mandible the incision should be carried out on the labial aspect of the sulcus and then obliquely downwards through the mentalis muscles to provide a sufficient thickness of tissues on the gingival side to hold sutures. A continuous horizontal mattress suture line will bring the deeper tissues together and evert the wound margin, but should not be drawn excessively tight, nor should large bites of tissue be taken at each horizontal step or the wound edge will be strangulated and slough. The epithelial edges are coadapted by oversewing with a continuous plain suture.

INSTRUMENTATION

In general incisions in the perioral tissues are made with a No. 15 blade. The scalpel handle is held at an acute angle with the proposed incision line but with the flat of the blade at right angles to the surface. This way much of the length of the cutting edge will be employed in making the incision and it will be deepened progressively down to the level of the tip of the blade. If the knife is held with the blade vertically in the tissues they will tend to bunch up ahead of the blade and a ragged cut will result. Where mucoperiosteum is being incised, the tissues are held steady by the underlying bone and a clean cut is easily produced. Where soft tissues unsupported by bone are being cut they must be stretched gently at right angles to the line of incision, for example on the inner aspect of the lip. Where thick tissues are to be divided, such as those over the anterior border of the coronoid process, the incision can be deepened progressively by a succession of passages of the knife. This way the direction of the cut can be controlled, divided vessels identified and picked up with artery forceps and damage to any important structures avoided. If an attempt is made to divide the full thickness in one sweep of the knife the operator will be tempted to plunge the scalpel blade in at right angles to the surface so bunching up the tissues as described above or resorting to a sawing motion, all of which will result in a ragged incision.

In order to incise the periosteum cleanly, a degree of pressure onto the bone must be maintained as the blade is advanced. After a short while this will blunt the edge of the blade. Incising over an unerupted tooth will also damage the scalpel edge and a new blade should be fitted before further incisions are made.

Loose connective tissue can be broken down by pushing the ends of the closed blades of a pair of scissors into the tissue then opening them. Performed with care this type of blunt dissection will permit vessels and nerves which are passing through such tissue to be displayed. The excessive use of blunt dissection, however, is a bad habit which will cause unnecessary tissue damage, untidy wounds and imprecise surgery. Scissors can be used as an alternative to a scalpel to divide sheets of soft tissue, usually thin muscles and sheets of connective tissue and mostly in a direction across the fibres. They are also used to divide loose connective tissue to avoid excessive blunt dissection.

Periosteum is raised from the bone with periosteal elevators. These may have a thin rounded edge or a sharpened edge flush with one surface and the end may be curved to enable it to be applied closely to curved bone surfaces. A blade end set at an angle to the handle like a hockey stick is used in cleft palate surgery and angled Warwick James' root elevators may be used as substitutes for such periosteal elevators to raise the edges of palatal incisions.

Large bi-angled spoon excavators also form excellent miniature periosteal elevators when it is necessary to raise soft tissues from bone in a confined space such as a cyst cavity.

The fibers of most tendinous insertions lie almost parallel with the surface and a periosteal elevator advanced from the bone to the edge of the insertion will slip up over the surface of the tendon. The muscle insertion should be approached from the side.

FLAP REFLECTION

Flaps are raised by dissecting parallel to the surface at the junction of tissue layers. Where these have similar

mechanical properties, such as the junction of soft tissue layers sharp dissection is used. Mostly dental surgeons are intent upon exposing the mandible and maxilla so that flaps are raised subperiosteally. This is done by blunt dissection with a periosteal elevator, making use of the well-defined plane of mechanical discontinuity between the soft tissues and the hard bone. The attachment of the periosteum to bone varies in strength from place to place. The interdental papillae are firmly attached to the cribriform surface of the tops of the interdental septa. In the edentulous jaw this cribriform bone forms a narrow continuous strip along the crest of the ridge. Connective tissue fibers and vessels which pass from bone to periosteum resist separation by the periosteal elevator and it may be necessary to cut them with a scalpel. The surface of the bone beyond the alveolar process can be exposed by further elevation of periosteum and overlying soft tissues, but a sufficient mesiodistal length of flap needs to be developed to permit adequate retraction and comfortable access to the bone at the operation site. On the outer aspect of the body of the mandible several structures are encountered which require special attention. Foremost of these is the mental nerve. As the periosteum is reflected in the region of the apices of the mandibular premolar teeth, care should be taken until the foramen is found. Gentle use of the periosteal elevator will preserve the mental nerve and vessels inside their conical sleeve of periosteum.

Special care should be taken where the patient is edentulous. If the alveolar process is atrophic the mental foramen will be relatively close to the crest of the ridge. Indeed where resorption has been extreme the nerve may emerge on the crest of the residual ridge and can be seen radiating outwards beneath the mucosa.

Anterior to and below the mental foramen there are the origins of the depressor labii and depressor anguli oris muscles and the insertion of the platysma muscle. These add only a marginally stronger attachment of the soft tissues to the mandible. In contrast, the origin of the mentalis muscle below the incisors requires a substantial effort. Indeed the periosteum is firmly attached over the whole mental eminence.

The attachment of the buccinator to the mandible is easily disrupted, but it should not be raised unless the additional access is definitely required. Once the edge of the muscle has been separated edema of the buccal space is facilitated producing a greater degree of facial swelling postoperatively. As the body of the mandible is uncovered buccal to the second molar it should be remembered that the facial artery and vein lie immediately external to the periosteum at this point.

More posteriorly the insertion of the masseter needs to be separated to expose the outer aspect of the mandibular angle. This requires little effort until the posterior border of the ramus and the lower border of the angle are reached. However, the tough, inelastic periosteum may need to be incised by a few gentle strokes across the inner surface to permit adequate retraction of the muscle to allow work on the underlying bone.

The shape of the mandible makes surgical access to its inner aspect awkward and this difficulty is increased by strong muscle origins. The genial muscles can be detached only by cutting through their origin, close to the tubercles and of course if complete detachment is necessary, they should be reattached. The sublingual arteries enter the mandible through a single foramen just above the tubercles and if divided they must be ligated or the bleeding from them arrested with coagulation diathermy. The mylohyoid origin extends from the third molar region to the midline and is not at all easy to separate from the bone, mainly because the muscle slopes downwards and the periosteal elevator more easily perforates the thin lingual periosteum and slips over the surface of the muscle rather than lifting it from the bone. It may be detached, if this is necessary, by hooking a narrow, curved elevator beneath the posterior border and detaching it from below upwards. This should be done with care and it may damage the mylohyoid nerve producing a transient patch of cutaneous anesthesia on the point of the chin. Naturally in the elevation of the mucoperiosteum on the lingual aspect of the 3rd molar region the lingual nerve must be safeguarded. Even the exposure of no more than the lingual aspect of the

alveolar process requires care because, except in the 3rd molar region, the mucoperiosteum is thin and easily torn. Any tear in the lingual periosteum will permit blood to spread into the lax tissues of the floor of the mouth forming a bulky hematoma.

As the outer surface of the maxilla above the alveolar process is uncovered few obstacles are encountered. The buccinator attachment is barely noticed and there is only little resistance from the levator anguli oris. In contrast the depressor septi muscles form a fleshy zone over the central Incisors which requires some care during flap reflection. Once the anterior bony aperture of the nose is reached the reflection of the periosteum into the nasal aspect of the maxilla impedes further mobilization of the soft tissues. Caution should be exercised high on the anterolateral aspect of the maxilla to identify and preserve the infraorbital nerve. This is done by elevating the soft tissues with a swab enclosed finger. Behind the zygomatic buttress or zygomaticoalveolar crest on the posterolateral aspect of the maxilla again the periosteum should be raised gently. It is easily stripped from the bone but care is necessary to avoid unnecessary damage to the posterior superior dental artery as it enters the bone. Exploration high up on the back of the maxilla leads to its disruption and the onset of a brisk ooze. While the hemorrhage is usually on a small scale. It can be troublesome in this corner where visibility is bound to be poor. Also a breach in the periosteum will release the buccal pad of fat creating an even greater impediment to vision. The mucoperiosteum of the hard palate is normally raised by incising the interdental papillae or by making an incision around the crest of the edentulous ridge. The palatal mucoperiosteum is tightly attached at the margin of such a flap so care must be taken not to use a tooth as a fulcrum for the periosteal elevator when it is raised. Initial elevation of the margin may be facilitated by using the spoon-shaped end of a curved Warwick James elevator. The mucosa is also tightly attached to the median palatal suture and tethered to the contents of the incisive fossa. Normally a generous length of the curvature of the upper dental arch is needed

to form a useful flap. However, radially placed relieving incisions can be made to limit the amount of mucosa which is raised to gain access to the surgical site. These should be short so as not to cut the greater palatine neurovascular bundle. Division of the palatine artery leads to a brisk hemorrhage which is best controlled by elevation of the posterior margin of the cut, the application of hemostat and underrunning the vessel with a resorbable stitch which is then tied to form a ligature.

In order to raise the full width of the palate elevation is started at a premolar interdental papilla on each side and separation is carried up to and around the incisive fossa structures. The nasopalatine nerves and vessels are divided as they enter the deep surface of the flap and rarely cause trouble either with hemorrhage or post-operative loss of sensation. Posteriorly the greater palatine neurovascular bundles in the adult emerge opposite the second molars and must be preserved with care. Damage to both can result in death of the flap. Damage to one may result in cyanosis of the edge of the flap.

Access just to the centre of the palate can be made by a midline incision. The mucosa is thin, as well as tightly adherent on either side of the midline, but can be raised with care and retracted to expose the underlying bone. A V shaped extension about the incisive fossa anteriorly increases access if this is necessary, but should not extend so far laterally as to divide the palatine vessels. Further reflection of the mucosa can be achieved by a V shaped cut at the posterior end but the thickness of the mucosa at this site makes such an extension less helpful. In making a posterior V shaped cut the incisions should not be carried on to the soft palate nor should they be made so as to endanger the greater palatine vessels.

TYPES OF FLAPS

- *Envelope flap:* In this type of flap, only crevicular incisions are given and mucoperiosteal flap is raised (Figure 7.10).
- *Three cornered/triangular flap:* In this type of flap, in addition to the crevicular incisions, one release

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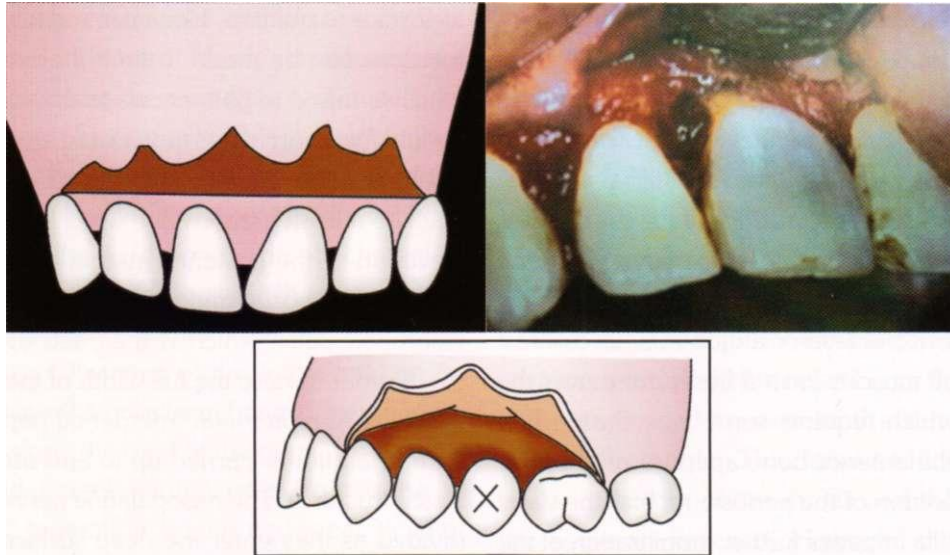


Figure 7.10: Envelop flap

incision usually anteriorly is given, such that the flap has two edges and three angles (Figure 7.11).

Four cornered flap: In this flap there are two releasing incisions in addition to the crevicular incision. Thus this flap has three edges and four angles (Figure 7.12).

The release incisions should lie on the mesio-buccal or distobuccal line angle of the tooth and on sound bone (Figure 7.13).

Release incisions on the facial aspect of crown don't heal properly due to tension and sometimes results in vertical clefting of bone.

- Incisions that cross gingival papilla damages the papilla unnecessarily and increased chances of localized periodontal problems.

INCISIONS (FIGURES 7.14A TO C)

- They play a vital role in health of flap and post-operative healing.
- They should be made over intact bone.
- They should lie at least 6-8 mm beyond the anticipated bony defect so that it lies on sound bone. If incision lies over bony defect—it will tend to collapse into the defect and result in wound dehiscence and delayed healing.

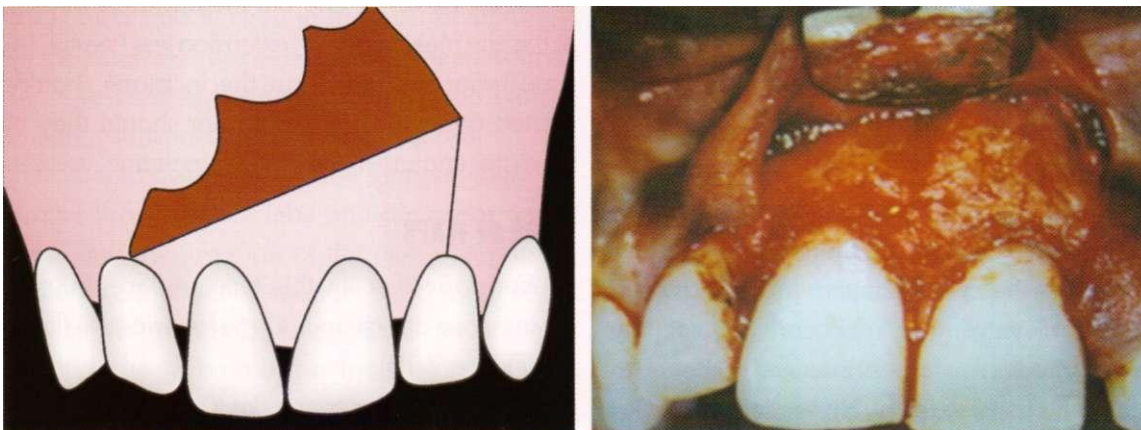


Figure 7.11: Triangular flap

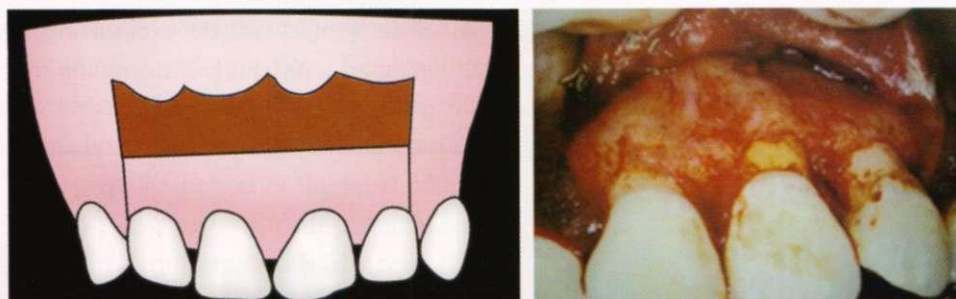


Figure 7.12: Four cornered flap

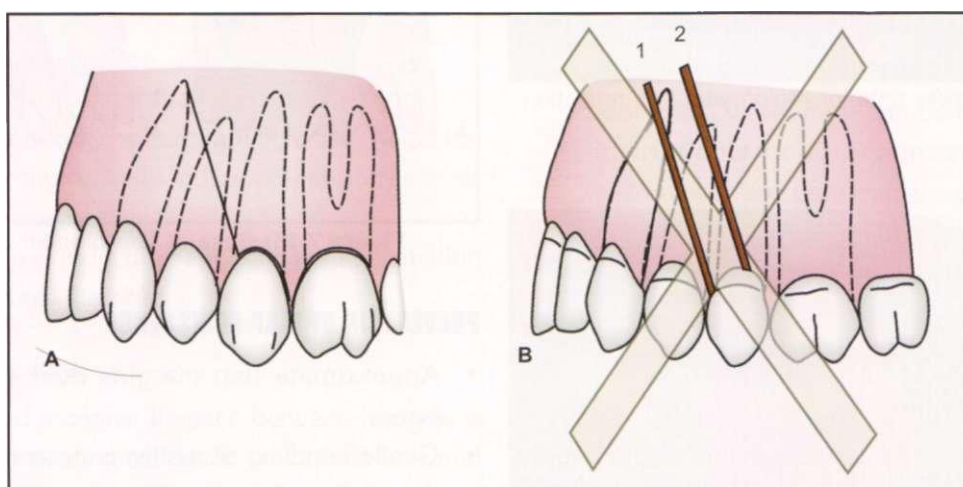


Figure 7.13: Mesio buccal or disto buccal line angle of tooth

Firm pressure should be applied while placing incisions.

Periosteum should be incised simultaneously.

A single stroke, without breaking continuity, must be used to avoid ragged borders. Avoiding ragged borders affects healing. Smooth borders lead to primary healing, ragged lead to secondary healing and scarring.

Blade should be changed if more than one flap is to be raised because there is blunting of the blade on contact with the periosteum and bone. Hence, for clean incisions, while raising a second flap, one should change the blade.

Reflection of flap begins at papilla with sharp end of elevator.

Then broad end is used, it is inserted at middle corner of flap.



Figure 7.14A: Reflection of mucoperiosteal flap

Dissection is carried out with pushing stroke posteriorly and apically.

This facilitates easy, rapid and atraumatic reflection of mucoperiosteum.

Exodontia Practice



Figure 7.14B: Lower anterior region with flap reflection

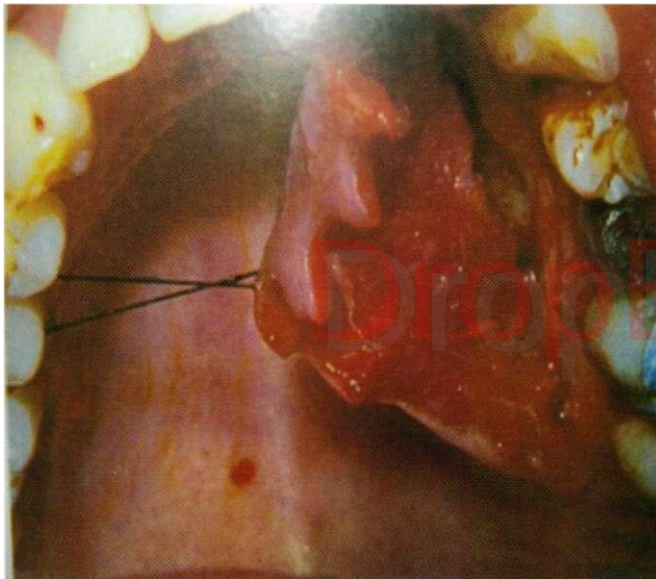


Figure 7.14C: Palatal flap reflection

PREVENTION OF FLAP NECROSIS (BLOOD SUPPLY OF FLAP!) (FIGURE 7.151)

1. Flap should be wider at base than apex to provide unimpeded blood supply to all parts of the flap. Necessary to avoid ischemic necrosis of flap and dehiscence (Figure 7.15).
2. Releasing incisions should converge at free end.
3. Length should not be more than the width. In maxillofacial surgery, length of the flap is usually half the breadth.

4. Base should not be excessively twisted/stretched, grasped with sharp instruments that might damage the blood supply of flap.

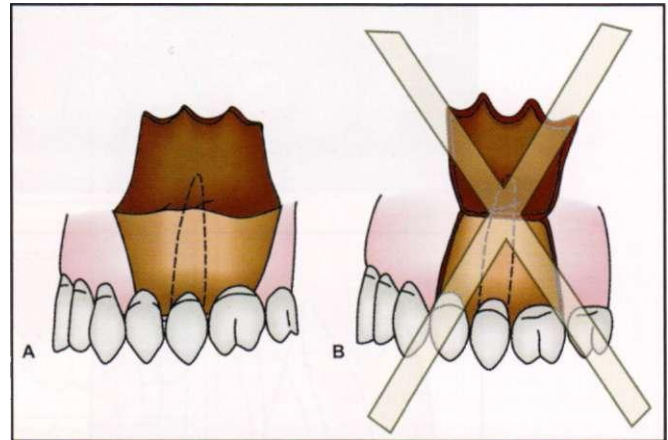


Figure 7.15: Base at flap broader than open

PREVENTION OF FLAP DEHISCENCE

- Approximate flap margins over sound, healthy bone.
- Gentle handling of tissues is necessary to maintain the vitality of the tissues.
- Tensionless suturing to prevent necrosis of the flap margins and dehiscence____
- Dehiscence causes bone exposure which causes severe pain, bone loss and increased scarring

AVOID VITAL STRUCTURES

- *Mental nerve:* In premolar region use envelope flap as far as possible. As flap is reflected care should be taken until mental foramen is found. Gentle use of periosteal elevator will preserve mental nerve in its conical sleeve of periosteum. In edentulous arch with ridge resorption- mental foramen will be close to the ridge crest.
- *Lingual nerve* comes in mandibular 3rd molar surgeries. A lingual flap if raised should be subperiosteal as the nerve lies in the suprapariosteal plane.
- *Facial artery:* releasing incisions at lower 1st molar site should be curved at its lower edge to avoid the facial artery.

- *Greater palatine vessels:* damage to these vessels is avoided by avoiding a palatine flap. Controlling bleeding from greater palatine artery is very difficult.
- If anterior palatine flap is raised, nasopalatine nerves and vessels can be easily incised at the level of the foramen. Bleeding can be controlled easily. In addition nerve can regenerate quickly and the temporary numbness does not bother the patient.

CLOSURE

- Achieves approximation of flap margins.
- Accurate apposition of flap—primary healing.
- *Tensionless sutures:* If sutures are tight they might cut through or compromise blood supply causing necrosis and dehiscence of flap.
- Suture tightness judged by avoiding tissue blanching but knot should be tight.

Functions of Sutures

1. *Coapt wound margins:* If space between margins is less, primary healing will result which will be rapid and complete.
2. *Hemostasis:* Sutures play a role in hemostasis in oozing socket but not in case of profuse bleeding. Profuse bleed—chances of hematoma due to continuity of bleeding in underlying tissues. In Oozing socket, bleed is controlled due to tamponade. However, sutures should not be tight.
3. Holding soft tissue flap over bone. Bone that is bare is very painful. It becomes non-vital and requires longer time to heal.

ADVANTAGES OF LONG FLAPS

- Adequate visualization.
- Healing by first intention- rest on sound bone.
- Flaps not to overextend in vertical direction to avoid vital structures.

AVOIDING BUTTON HOLED FLAPS

- In chronic sinus cases sometimes need to include sinus in the tissue flap to avoid button holing of the flap.

BONE REMOVAL

- **"Bone belongs to the patient and tooth to the surgeon"**
- Unnecessary bone removal must be avoided
- Bone removal is divided into removal before tooth delivery and bone removal after tooth delivery.
- Bone removal before tooth delivery.
 1. Removal of buccal cortical plate (1/3rd of retained root surface to be exposed): Before delivery. Buccal bone removal done for adequate visualization of tooth root. It improves access and brings root in full view which can be removed by hand instruments or rotory instruments. Rotory instruments are preferred because hand instruments chisel and mallet may strike root and fracture root with bone at same level and there is need for more bone removal. Also the sensation is unacceptable under local anaesthesia. With bur avoid cutting into root. Round burs are preferred over straight fissure for bone removal because cooling is easier and faster and visualization is good.
 2. Guttering of buccal bone: In this trough created between bone and tooth on buccal and/or mesial or distal aspect and height of alveolus is maintained.
 3. Postage stamp method: Buccal cortical bone is removed upto 1/3rd height of root. This technique is also used for retained apical 1/3rd of root (Figure 7.16).

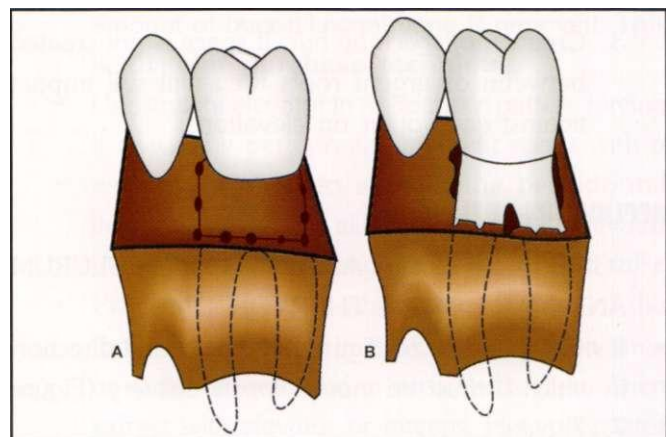


Figure 7.16: Bone removal: Postage stamp method

- Use of coupland chisel for bone removal can be done under local anesthesia because it involves use of hand pressure for bone cutting.
- Use of chisel and mallet can be done under general anesthesia.
- Two vertical cuts, one anterior and one posterior and one horizontal cut connecting both the vertical cuts.
- Bevel of chisel should face bone that is to be cut—faces mesially for distal cut and *vice versa* and occlusally for horizontal cut.
- Bone removal after tooth delivery is performed to achieve the following:
 1. To smoothen sharp bone margins.
 2. Reduce size of clot by reducing size of socket.
 3. Recontour the residual alveolar ridge for prosthetic rehabilitation.

TOOTH SECTIONING

- Also known as odontectomy. Fragments can be removed easily one by one, we can section crown from root, separate cusps, separate roots or perform a combination.

Advantages:

1. Individual sections with different paths of withdrawal can be removed easily.
2. Splitting of roots better with burs because of definite control over splitting, although it is more time consuming.
3. *Creation of space by bur*: If space is not created between divergent roots they will still impact against each other on elevation.

APPLICATION OF ELEVATORS

- "GIVE ME A LEVER AND A SECURE FULCRUM AND I WILL MOVE THE WORLD"
- It will depend on configuration of root and direction in which it must be moved for its delivery (Figure 7.17).

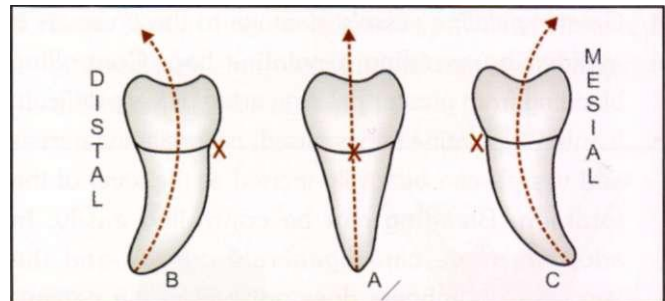


Figure 7.17: Diagrammatic representation showing correct method of application of elevator in curved root

- Straight roots can be elevated from any side (Figure 7.18)

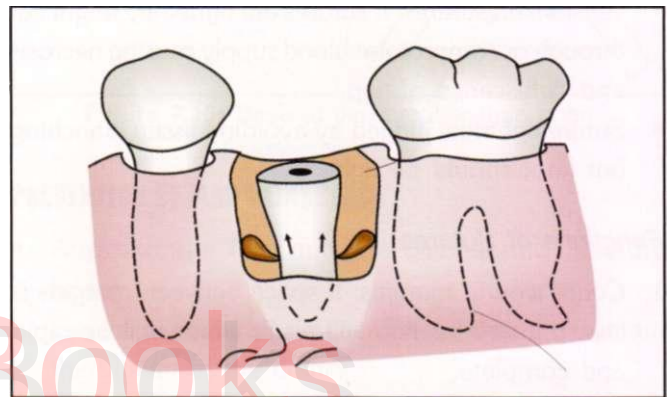


Figure 7.18: Diagrammatic representation of application of elevator in straight root

- In curved roots elevator to be applied on convex side. If applied on concave side root will get forced against bone- further fracture of root (Figure 7.19).
In multirooted tooth with roots curved in same direction, elevator applied on convex aspect of whole root complex.

Multirooted teeth with roots having conflicting lines of withdrawal:

1. *Divergent / recurved root pattern*: Roots should be separated before application of elevator to convex surface of each. Occasionally elevator can be applied to unfavorable surface in case of infected root / resilient bone / bone loss without fracture of root and if space has been created between the two roots (Figure 7.20).

Transalveolar Extraction (Complicated Exodontia)

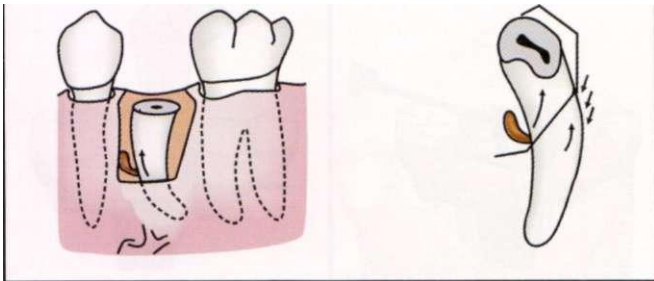


Figure 7.19: Application of elevator on greater curvature of root

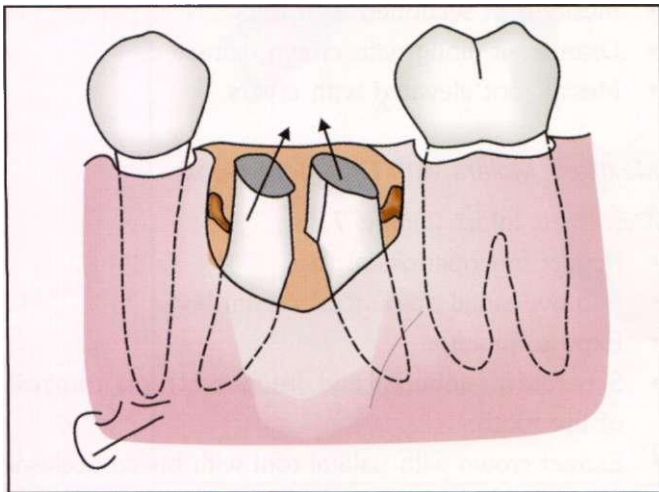


Figure 7.20: Root sectioning and removal of root

2. *Convergent root / curved roots:* elevator is applied to convex surface (Figure 7.21)

- Elevators should be applied with modest and controlled force.
- Sometimes it is essential to make more secure place for application of elevators. This is done by drilling notch in side of root which is more apically at its depth. This will resist root fracture when elevation is attempted. Round bur is used at an angle of 45 degrees to long axis of tooth (Figure 7.22).

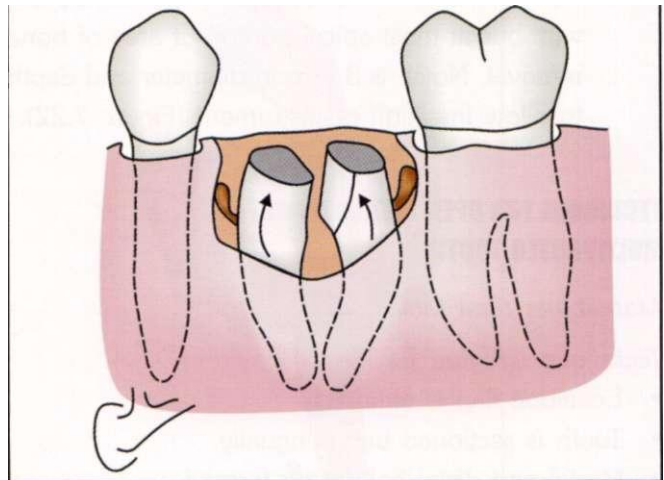


Figure 7.21: Root sectioning and application of elevator in curved roots

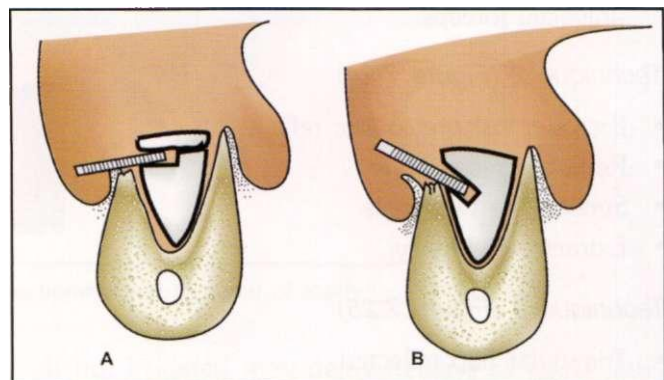


Figure 7.22: Preparation of purchase point

TECHNIQUE FOR OPEN EXTRACTION OF SINGLE ROOTED TOOTH

1. Provide adequate visualization and access by raising a flap.
2. Determine need for bone removal
 - Reset extraction forceps under direct visualization—extract.

- *Grasp a bit of buccal/Ungual bone:* Improve mechanical advantage—grasp tooth root. Small amount of buccal/lingual bone is removed. This is **alveolar purchase technique**.
- Use straight elevator in a shoehorn pattern forcing it down the periodontal ligament space with a wiggling motion to expand the periodontal ligament space and allow small straight elevator to enter as a wedge and displace root occlusally.
- Proceed with bone removal over area of the tooth. Bone removal in mesiodistal direction same as width of tooth and in vertical direction. Then extract with elevator or forceps. Heavy elevator 'crane pick' can be used.

- If still difficult to elevate, prepare a purchase point with bur at most apical portion of area of bone removal. Notch is 3 mm in diameter and depth to allow insertion of instrument (Figure 7.22).

TECHNIQUE FOR OPEN EXTRACTION OF MULTIROOTED TOOTH

Mandibular First Molar

Technique 1 (Figure 7.23)

- Envelope flap is reflected.
- Tooth is sectioned buccolingually.
- Mesial and distal halves are formed.
- Sectioned tooth is treated as two single rooted teeth.
- Luxated with straight elevators and extracted with universal forceps.

Technique 2 (Figure 7.24)

- If crown lost previously; reflect flap.
- Remove crestal bone.
- Section the two roots.
- Extract individually.

Technique 3 (Figure 7.25)

- Triangular flap reflected.
- Sufficient buccal bone removed to expose bifurcation.

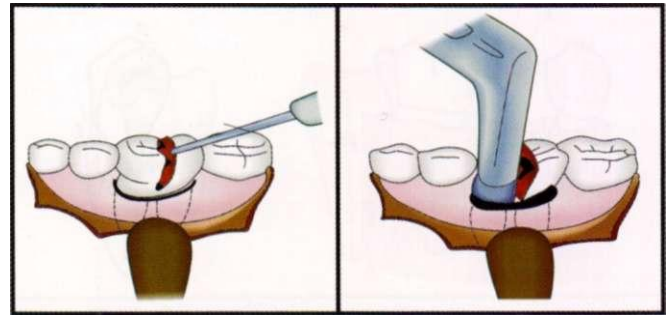


Figure 7.23: Vertical split of crown and its removal

- Mesial root sectioned with burs.
- Distal root along with crown extracted.
- Mesial root elevated with cryers.

Maxillary Molars with Divergent Roots

If crown is intact (Figure 7.26):

- Reflect mucoperiosteal flap.
- Remove small amount of crestal bone.
- Expose furcation.
- Separate mesiobuccal and distobuccal roots from rest of the tooth.
- Extract crown with palatal root with bucco-occlusal pressure.
- Palatal root with crown are delivered along long axis of palatal root.
- Avoid palatal force to prevent palatal root fracture.

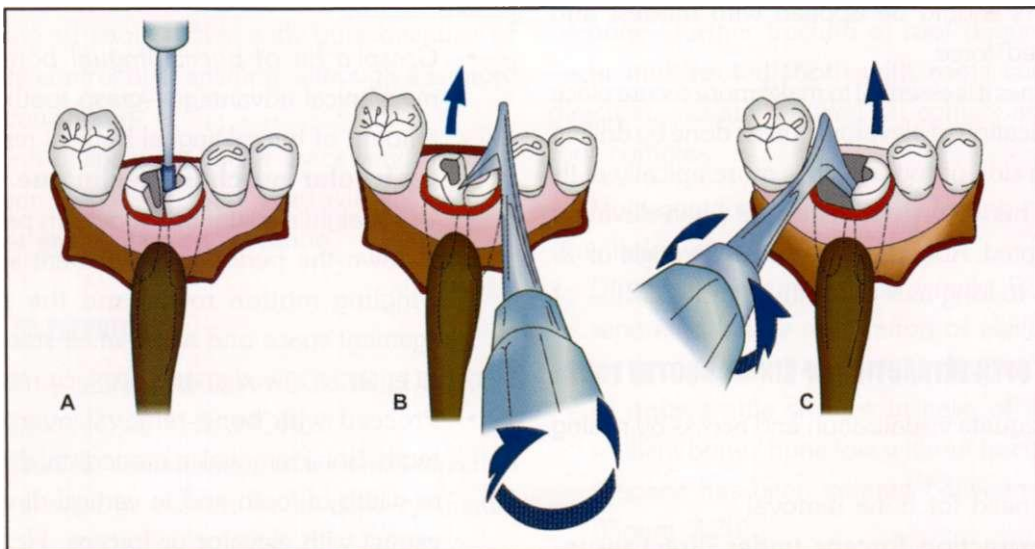


Figure 7.24: Sectioning of mesial and distal roots and its removal

Transalveolar Extraction (Complicated Exodontia)

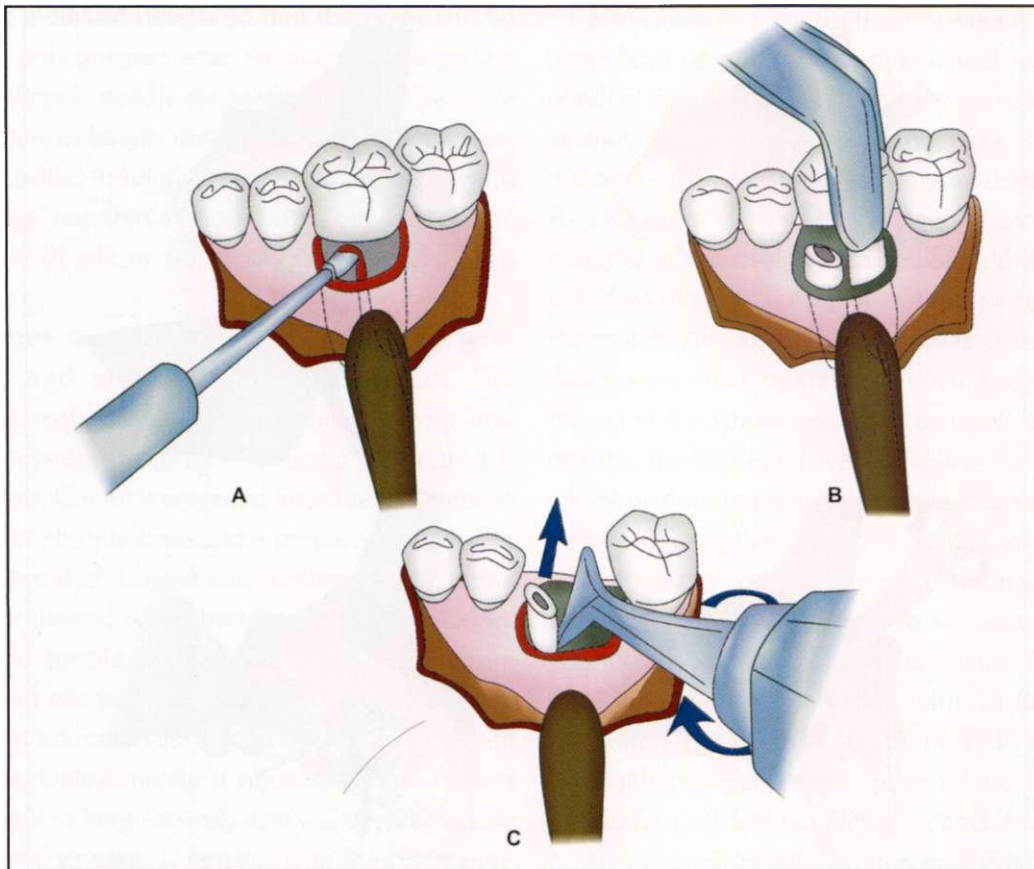


Figure 7.25: Another method of sectioning and removal of tooth

- Elevate buccal roots one by one using straight / cryer elevator. Avoid too much apical force to avoid sinus perforation. Apply maximum force mesiodistally.

Crown is missing/fractured

- Divide the three roots.
- Extract them individually.
- First extract buccal roots, then extract palatal root.

SOCKET TOILET

- Removal of tooth/root does not complete the procedure.
- Progress of healing and after-pain depends on socket toilet.
- Irrigate with copious amounts of normal saline in the socket and apical portion of flap where it joins bone because it is a common place for debris collection.

If not irrigated may delay healing or cause subperiosteal abscess.

- Remove infected granulation tissue using a curette.

SUTURING

Incisions are closed and the tissues held in contact with one another to permit healing by first intention by the use of sutures. Hemostasis should be secured always before the wound is closed. While the act of suturing the wound will arrest a slight ooze from the surfaces which the stitches bring together this cannot be relied upon. If bleeding continues after the wound has been closed a hematoma will form. This may either take the form of a clot which creates a dead space in the tissues. Hematomas increase the volume of the tissues, expand flaps from the underside impairing their blood supply and creating tension at the suture line. The tissues within

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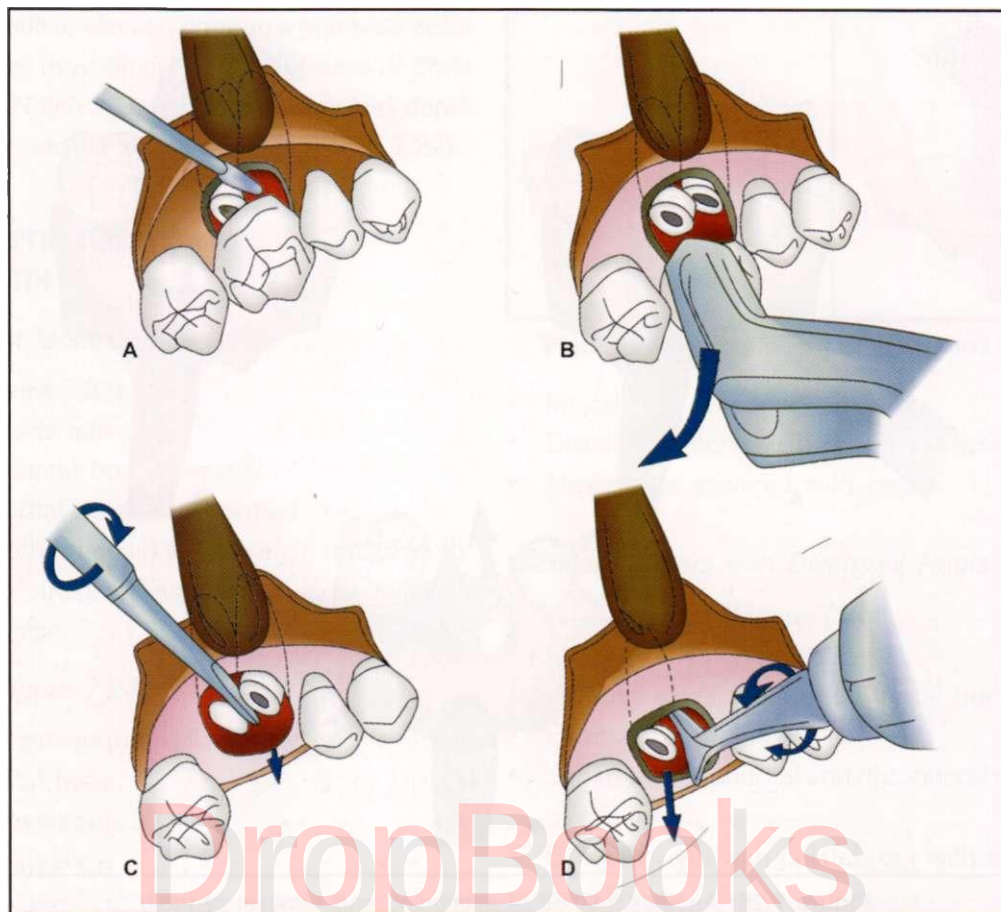


Figure 7.26: Method of sectioning and removal of maxillary molar

the bite of the sutures are also excessively compressed and necrose so that the suture cuts out and the wound opens, the so-called 'burst' suture line. Secondary infection will follow. Hemostasis therefore must precede wound closure.

The cheapest sutures are undoubtedly those made from eyed needles and a suitable length of suture material cut from a reel. However, most suture materials and needles are difficult to sterilize, The needles are also difficult to clean after use and become blunt and work hardened so that they snap.

Modern sutures are prepared commercially and sterilized by gamma radiation. The needles are eyeless, with the end shaped as a tube into which the suture thread is swaged. These 'atraumatic' sutures pass through the tissues with minimal effort and damage.

Needles may be either round bodied or cutting. Cutting needles are flattened on two or more aspects behind the needle point to raise sharp edges which aid penetration of tough tissues. Round-bodied needles dilate a hole for the thread so that delicate tissues are less likely to tear and the stitches cut out. The thread also fits tightly in the hole to make a water-tight suture line. Large needles may be handheld, but small needles such as are required for suturing in the mouth are held in needle holders. There should be a portion of the needle shank which has flattened surfaces which may be held by the needle holder and which prevent the gripped needle from rotating. It is a fault of some modern needles that this necessary flattening of the surface may not be present.

Needles are also either straight or have varying degrees of curvature. Suturing in a limited space is

Transalveolar Extraction (Complicated Exodontia)

facilitated by a curved needle so that the point can be readily seen and grasped after rotating it through the tissues. A half circle needle is usually chosen. These are 22 and 25 mm in length measured around the curve, and are well suited to relatively thin layers of tissue and the small 'bites' required to close them. Suture material of 2 metric (3/0) silk or polyglycolate is usually used in the mouth.

The sutures may be either absorbable or non-absorbable and monofilament or braided. The traditional absorbable suture material is catgut and despite the appearance of new synthetic materials it is still widely used. Catgut is prepared from the collagenous adventitia of lambs intestines and is prepared either plain and simply stranded, twisted and sterilized with gamma irradiation or treated with chromate, i.e. chromic gut. to increase its tensile strength and delay absorption. However, synthetic polymers the polyglycolate and the polyglactin suture materials, are stronger and less irritant to the tissues. Unfortunately if uncoated these sutures may be difficult to knot securely and will spontaneously untie unless the surgeon is familiar with their behavior. Polyglactin sutures are coated with polyglactin 370 and calcium stearate (Vicryl-Ethicon) which reduces drag.

In general, non-resorbable materials creates little tissue reaction but because they are not destroyed by the tissues are only used where they can be removed or buried deeply in situations where permanent support from the sutures is required and where subsequent infection of the foreign material is unlikely. They may be either monofilament or braided. Braided materials are generally more flexible and are easy to knot and so are more suitable for suturing the mucous membrane of the mouth. Natural fibers, such as silk, with their slightly roughened surfaces hold knots better than smooth surfaced artificial fibers. However, a braided thread will act as a wick for moisture and accumulate debris and microorganisms which can irritate the wound. To prevent this, braided sutures are often coated and made water repellent with wax or silicone.

Monofilament synthetic polyesters such as polypropylene or polyamide (nylon) will not absorb and conduct liquids in this way but are more difficult to knot as they have an intrinsic springiness. Therefore only 4-0 or finer gauge monofilaments are used in the mouth. As elsewhere in the body, catgut or other absorbable material is used for buried sutures although these are not often required during operations performed through the mouth. Absorbable sutures are also used for mucosal flap closure when operating on young children to avoid the need for suture removal, or in all age groups for suturing the inside of lips and cheek or the floor of mouth where postoperative oedema may make the sutures cut in to a degree that they are difficult to remove. Sizes 3/0 (3 metric) to 6/0 (6 metric) of catgut are chosen, dependent upon the tissues to be sewn.

Needle holders with narrow beaks are required to hold small, curved needles without flattening their curvature. The handles should be sufficiently long that the holding fingers do not obstruct the surgeon's view.

Modern eyeless needles are difficult to hold without a ratchet type needle holder and this can be a disadvantage in awkward corners of the mouth.

However, they are less highly tempered than the eyed needles and much less likely to snap if accidentally bent. The needle holder is clamped on to the needle at a position about two-thirds of the distance from its tip. If the needle is held correctly in this manner the length between the jaws of the needle holder and the point is sufficient to allow the needle to be inserted about 2-3 mm from the wound edge, and rotated through the tissues so that enough of the pointed end emerges from the wound to be gripped and drawn through. The flap is controlled with either toothed dissecting forceps or a skin hook and the edge everted as the needle is passed. The needle point enters at right angles to the surface and it should penetrate completely through a muco-periosteal flap to obtain the maximum grip, but emerge near the bottom of the soft tissue incision ensure that there is no dead space, left after it has been tied. Eversion of the first side of the flap enables the curved needle

Exodontia Practice

to travel through the tissue obliquely away from the incision to enclose a slightly larger bite on the deep aspect than at the surface.

In general the needle should be drawn out of the first side of the wound before the point is engaged in the other. Now the second side is everted with toothed forceps or a skin hook and the needle inserted from the underside of the flap. The needle is inserted into this side of the wound at the same depth that the thread emerges from the first side. Now, once the needle has penetrated into the second side the forceps or skin hook is detached from the edge of the flap and pressed against the surface of the tissues just beyond the hidden point of the needle. This action pulls the superficial tissues over the point so that the needle emerges closer to the wound edge than it would otherwise. This way again the needle embraces a greater width of tissue deeper in.

Now when the stitch is tied the wound edges are everted slightly. Eversion of the wound edges increase the area of contact and so improves the early strength of the healing wound. As the scar contracts a flat surface results. The distance of the needle punctures from the edge of the flap should be less than the depth to which the stitch penetrates into the tissues, particularly with mucoperiosteal flaps or one edge will overlap the other as the knot is tied. Overlapping will also result if unequal depths of flap are embraced by the stitch. Excessive depth of bite in relation to width, on the other hand. Results in excessive eversion and gaping of the approximated wound at the surface.

In the mouth, one side of the wound often constitutes the flap and has been freely elevated from the bone and the other side remains attached to the bone almost up to the incision. The edges of the fixed margin, however, will have been raised for a sufficient distance to permit penetration of the full thickness of the flap by the needle. Suturing from loose to fixed flap usually enables finer repositioning and reduces the chance of the suture tearing through the fixed thin tissue layers. However, comfortable suturing is important to good technique and to this end

it is preferable, where appropriate, to sew from the edge further from the operator to the nearer one.

A knot is now tied, either by hand or with instruments. If the knots are tied by hand more thread is wasted than when instrument tying is employed, particularly where the knots have to be formed towards the back of the mouth. The technique of instrument tying therefore will be described. Furthermore, it is easier to see what is happening if instruments are used in the confined space of the mouth.

The needle is drawn out of the second side of the wound and the thread pulled through until a length of about 4 cm remains protruding from the entry puncture. The needle is taken from the needle holder with the index finger and thumb of the left hand. The excess suture is taken up into the palm of the left hand, using third and fourth fingers and the thread grasped again with finger and thumb about 8 cm from the wound. The beaks of the needle holder are brought across the front of the thread and rotated in a circle to pick up two loops of the thread. The short end is now gripped at its end with the needle holder and the loops slide off the beaks onto the thread by rotating the needle holders so that the beaks point towards the left and by drawing on the long end with the left hand. The short end is given a short downwards jerk which tumbles the loops into a slip knot, which is positioned just beyond the tips of the beaks and with the short length emerging from under the loops. By drawing on the long thread the knot may be made to slide down onto the tissues at the exit puncture. The short end should not be pulled as if this is done an unstable knot will result. Tension upon the long end also results in a short end which needs minimum trimming subsequently. The short end will emerge between the loops and the tissues and the knot will not slip while the long end only is under tension. As this first knot is tightened the left hand moves away from the operator's body and across the wound.

To form the second throw of the knot the needle holder beaks are brought across the long thread from behind and the points rotated downwards, away and

to the right to pick up a single loop. The short end is again clamped but should *not* be pulled upon. The loop is drawn off the needle holder beaks and the knot tightened by traction upon the long end only with the left hand. Final tightening is accomplished by drawing the long thread towards the operator and the short end away, across the wound. A third throw will prevent any chance of a knot slipping, particularly if a synthetic suture is being tied, or of the knot untying as it absorbs moisture from the saliva in the case of catgut. The loop is formed as for the first throw, but only one loop is picked up. The left hand travels away from the operator and across the wound to tighten the knot. The thread ends are held up and cut off by the assistant.

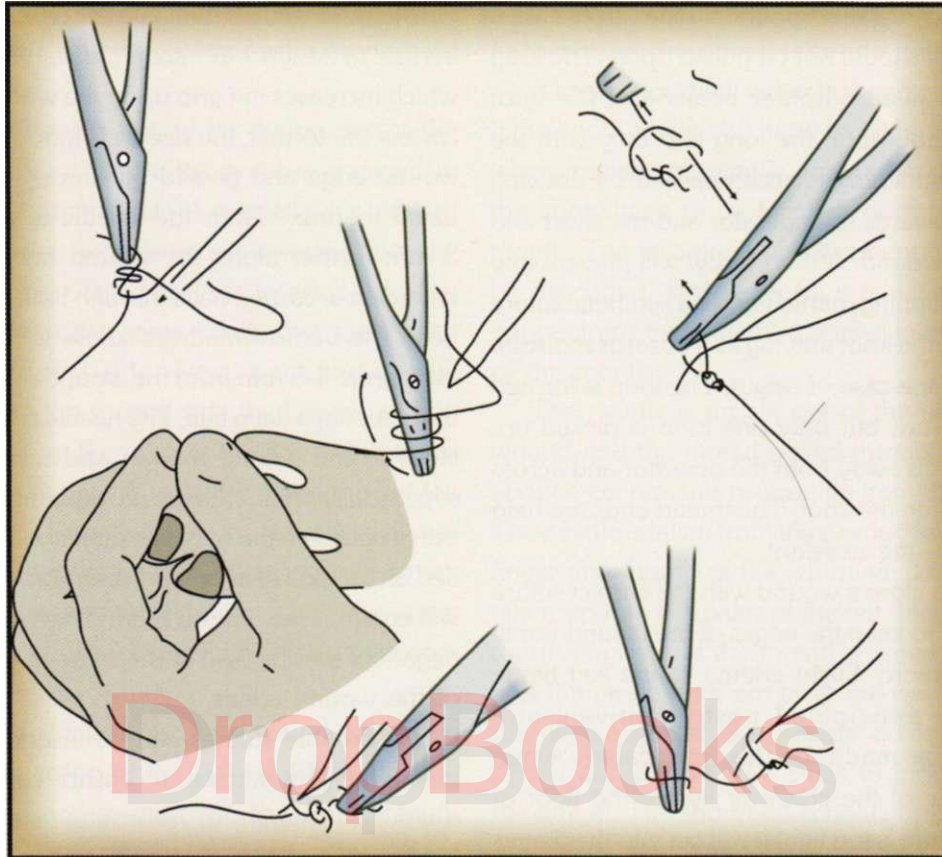
It is essential to close a wound with the correct suture tension, sufficient to keep the edges of the wound firmly together, but no more. Slight edema of the soft tissue margins can be anticipated postoperatively and allowance must be made for this, particularly when suturing the inside of the cheek or lips or the floor of the mouth. If a suture is too tight it will cut into the tissues and produce scars at right angles to the healed incision, or stitch marks. Permanent suture scars depend more upon the tension of the sutures than upon the length of time before they are removed. To avoid irritation of the healing wound the knot should be manipulated so that it lies over the puncture point to one side of the wound. If an angled incision is used the apex between the two edges is correctly positioned first. Then the next two sutures are inserted at each mid-point between the ends of the wound and the first suture. The remaining sutures are interspaced at regular intervals.

Interrupted sutures are used for most oral surgical procedures though where long incisions are to be closed, continuous sutures are used. Where a continuous suture has been inserted the thread is drawn after the last penetration of the needle leaving a short loop on the other side of the wound. The mid point of this loop is grasped with the needle holder as the knot is tied, instead of the usual short end.

Mattress sutures, which may be either horizontal or vertical in design, embrace a greater volume of the tissue which increases the grip upon the wound margin. In the case of the former, the needle is introduced through one wound edge and passed out through the other in the usual manner. Then the needle is re-inserted about 3 mm further along the wound from the point of its emergence, carried back through both wound edges and tied. The vertical mattress suture is made by inserting the needle 4-5 mm from the wound margin and through the tissues in a deep bite. The needle is then re-introduced close to the wound margin and taken through more superficially in line with the previous direction of insertion, but of course in the opposite direction. The suture is then tied on the side of its original insertion. A vertical mattress will coadapt the wound margins where there is a small degree of tension and at the same time ensure eversion of the wound edges.

Absorbable sutures can be inserted to close layers below the skin surface, to ensure complete closure of a wound in depth, to reconstitute sheets of muscle or fascia and to eliminate potential dead spaces. The part of the suture which will persist longer than the rest and be likely to form a nidus for infection is the knot. If it lies under the outer suture line the bulk may affect the soundness of closure. For both these reasons the knot should be buried on the deep aspect of the suture line. The needle is inserted from the deep side of the layer to be sutured and reinserted from above downwards on the other side of the wound. When the knot is tied it will slip through between the approximated tissues.

The removal of sutures should be performed with care. They should be swabbed gently with chlorhexidine then each knot gripped in turn with non-toothed forceps. The external part of the suture is raised and the thread cut below the knot and flush with its point of emergence. In order to avoid a strain upon the healing wound the suture is drawn out across the wound. This draws the deep part of the suture out of the opposite puncture creating tension towards the wound rather than away from it. This prevents dehiscence of the healing wound



Figures 7.27: Suturing techniques

and also draws only the previously buried part of the stitch through the wound. Never cut through a stitch in such a way that part of the contaminated external loop is drawn through the wound. Above all, avoid cutting the suture in two places so that part of the suture is left in the tissues. As the suture is divided some compression of the tissues is released and the retained segment retreats into the depths of the tissue. Even if some micro-organisms have travelled along the suture material they do not produce a clinical infection in the ordinary way because a suture creates a wound which is drained at both ends. Leave a cut segment buried in the suture track and allow the puncture points to close so that there is no longer drainage and a stitch abscess will result.

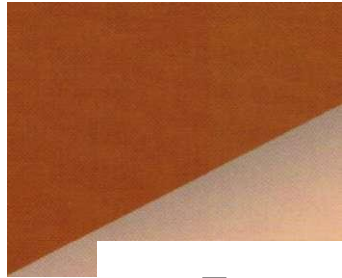
Functions of sutures are:

1. Coapt wound margins.
 2. Hemostasis—oozing socket but not in case of profuse bleeding.
 3. Holding soft tissue flap over bone.
 4. Maintaining blood clot within socket—use of gelfoam, oxidized cellulose.
- If flaps are snugly in position and bleeding is controlled, sutures are unnecessary.

AFTER CARE

- Maintenance of oral hygiene, especially at site of sutures.
- Avoid accumulation of irritants, plaque and food debris which will lead to infection and breakdown of flap.

Chapt 2 J



The Root Piece Removal (The Fractured Root)



A decision must be made whether to leave or remove a residual root. These requires anticipating whether the root fragment will remain asymptomatic or whether it will become infected and cause pain, perhaps lead to an abscess and a discharging sinus, develop a cyst or interfere with a denture. Occasionally mandibular roots may even sink towards the lower border creating greater problems in their removal.

If the root breaks after the tooth has become mobile the missing piece should be recovered for it is almost certain to become infected and cause pain. Conversely when the apex of a tooth with a vital pulp snaps off before the main body of the tooth has been loosened, the fragment is likely to be enclosed by the bone of the healing socket, and remain asymptomatic, and its removal can be deferred if necessary. Perhaps the only absolute indication for root removal is for patients for whom unpredictable local infection may become major risk such as those who have rheumatic or congenital heart disease or who are immunosuppressed.

IMPORTANT FACTORS FOR CONSIDERATION

The following factors need to be determined before decision to be made for removal of root piece.

THE AMOUNT OF ROOT RETAINED

When only apical 3rd or less of the root tip is retained it may be left. More often the socket heals satisfactorily and the root remains in the bone. However, sometimes, as time passes, the alveolus resorbes and eventually the root comes to the surface and may cause chronic discomfort or an acute infective episode. Late removal may be surgically easy, but may result in deficiency in the edentulous alveolus. Generally, root tips should be removed in patients below 50 years of age at the time of fracture, while in older patients, their general condition and the bone resorption rate should be considered.

THE SITE OF FRACTURED ROOT

- i. Roots in the close proximity to anatomical spaces such as maxillary sinus and inferior dental canal

should be left at the time of fracture and elective surgical removal can be considered later.

- ii. If the root is in close proximity to an adjacent tooth, as in cases of displaced or dilacerated roots, and causes damage to the adjacent healthy tooth, then the root tip is better left alone.
- iii. The palatal root of the maxillary 3rd molars, particularly when the tooth is rotated, may be in the position where access to it can only be achieved by removal of the 2nd molar. Hence it is better -to leave such a root piece.

REASONS FOR EXTRACTION

- i. When a tooth is extracted for orthodontic purpose no root should be left behind as it may prevent movement of adjacent teeth into this space.
- ii. When there is periapical radiolucency present, the root as well as the periapical granuloma should be removed, or else it may develop into a cyst. Radiographic evaluation is mandatory.

AGE AND GENERAL MEDICAL CONDITION OF THE PATIENT

Very young, very elderly and certain nervous individuals may tolerate extraction of the tooth under local anesthesia but not the entire procedure of trans alveolar extraction. It is rather wise to stop the operation and make other arrangements for root removal than causing distress to the patient.

CIRCUMSTANCES OF THE FRACTURE

If the tooth has been luxated before the fracture occurred, the periodontal membrane may have been torn and any blood supply to the root may have been cut off. Such root then acts as a foreign body which may give rise to a septic socket or chronic infection in the bone. Such roots should therefore be removed.

TECHNIQUE FOR REMOVAL OF SMALL ROOT TIPS

When the apical 3rd of the root fractures, initial attempts should be made by the closed technique and

if unsuccessful, then by open technique. Whatever technique is chosen 3 basic requirements are of importance -Excellent light for illumination of field, Good suction for isolation of area and Good assistance.

THE CLOSED TECHNIQUE

It is a technique that does not require reflection of mucoperiosteal flap and removal of bone. The technique is most successful when the tooth has been well luxated and mobile before the root tip fractured. However, if the tooth was not well mobilised before fracture, closed technique is less likely to be successful. It may not be successful when the roots are hypercemented, dilacerated or when there is a bony interference.

Forcep Removal

The narrow bladed forceps i.e. root forceps, are invaluable for the removal of sizeable retained roots if used with care as follows:

- a. Always ensure that the blades are inserted beneath the gingival which may have to be elevated locally first.
- b. Always obtain a grip on an identified root rather than just grip the alveolus blindly.
- c. Press the forceps well down over the root. In the mandibular molar region a small amount of alveolar bone may have to be included.
- d. In the maxilla, apply the palatal forcep blade between the palatal and one buccal root and the outer blade buccal to the other buccal root where retained molar roots are being tackled.
- e. Apply a firm continuous force with a strong grip to expand the alveolus, at the same time moving the root only through a small arc while maintaining an apically directed pressure. Rapid rocking movements although popular are likely to fracture the roots.
- f. This approach is likely to remove one mandibular root or in the maxilla two roots, making the removal of the remaining one easier.

After a root has been recovered, verify that the removal is complete by fitting the tip to the previously

extracted portion of the tooth. If this precaution is neglected, the surgeon may discover that he has failed to retrieve the whole of a missing root. Indeed all teeth should be inspected carefully after extraction because some have an extra root and if this is fractured and retained, its absence may be overlooked by a casual glance at the tooth.

Endodontic files may help removal of root tips in certain situations. After proper visualization of the root canal is achieved, an endodontic file of an appropriate size is selected and screwed into the root canal at the fragment, until it firmly engages the root tip. The shank of the file is gripped with the needle holder, which is used as a lever to lift the root fragments from the socket. If the file pulls out of the root canal, a larger size file should be fitted into the canal and the technique attempted again. The endodontic files are not useful for removing root tips with non-visible canals, hypercemented roots, bony interferences and dilacerated roots that prevent proper access to the root canal.

A technique that is similar in concept to the endodontic file technique involves the use of the dental drill with a small round bur to drill into the tooth root. There may be sufficient friction between the bur and the tooth to permit the root to be removed when the drill is removed from the socket. This technique is more useful for larger root fragments than for smaller root tips.

Root tips can also be removed with a straight elevator. This technique is indicated more often for the removal of larger root tips than for smaller root tips. Straight elevator is forced into the periodontal ligament space, where it acts like a wedge to deliver the tooth fragment towards the occlusal plane. However care should be taken to avoid strong apical pressure which may force the root into the underlying tissues. This is more likely to occur in maxillary premolar and molar area where the tooth can be displaced into the maxillary sinus.

There are a number of other maneuvers which will enable the operator to remove a fractured root without resorting to a surgical procedure. However, too much time should not be spent in this way and if success is

not soon achieved the attempt should be abandoned and a flap reflected.

In certain cases one complete root of a multirooted tooth is fractured off and retained. With care it may be possible to place a sharp pointed elevator in the empty socket and rotate it to remove first the inter-radicular septum and then the root. This is often a successful method for removing lower molar roots but is less successful in the maxilla. The distobuccal root from an upper molar may be extracted in this way provided only gentle pressure is used with an elevator inserted in the mesial socket. Unfortunately the mesial root is difficult to remove through the distal socket, as the root curvature is unfavorable for the application of an elevator from the distal aspect. Mesio Buccal roots can be elevated by introducing a Coupland chisel or straight Warwick James elevator up the mesial periodontal membrane in order to turn the root downwards and backwards.

Elevators should not be used to remove the palatal root of an upper molar. The buccal wall of the socket does not form a satisfactory fulcrum and can be crushed by the elevating force. Furthermore there is always the danger of forcing the root into the antrum. The palatal root must be seen clearly, which usually implies the removal of both the buccal roots and, if necessary, some surrounding bone which can be done with a bur. Then gentle dislocation with a narrow Coupland's chisel or rotation with upper root forceps should deliver the root.

Sometimes a root apex is heard to fracture after the tooth has been loosened with forceps and it may be possible to see the apex clearly with the aid of a sucker. A probe or a thin root canal reamer or file can be introduced into the root canal and the loose apex is withdrawn with its aid.

So-called apical elevators are usually too thick to use to dislodge the apical third of a tooth root from its socket, but a stout, bi-angled spoon excavator may enter the periodontal space and topple it out. However, the movement will be a tilting one, pushing the sharp fractured edge on the other side of the root against the

socket wall. This may be sufficient to prevent the operator dislodging it out of the socket. A narrow groove cut around the end of the root with a rose-head bur may be sufficient to overcome this obstruction.

Used with discretion, these maneuvers can neatly remove a number of small retained fragments but again it must be emphasized that unless success is achieved early, further attempts will prove frustrating and time consuming. It is then much quicker to raise a flap, cut away some buccal bone and tease out the fragment with a fine elevator. Indeed if socket surgery is performed without caution, it can lead to roots being forced into the maxillary sinus or the inferior dental canal.

Where immediate simple measures have failed to deliver a root, a formal surgical removal is essential. This should not be undertaken without clinical reappraisal and adequate radiographs to localize the root fragments and identify the features which might explain the problem.

THE OPEN TECHNIQUE

If the closed technique is unsuccessful, the surgeon should attempt open technique. There are two main open techniques for removing tooth tips.

1. A soft tissue flap is reflected with a periosteal elevator and retracted with a right angled retractor. Bone is then removed with a chisel or bur to expose the buccal surface of the tooth root. The root is buccally delivered with a straight elevator. The flap is repositioned and sutured.
2. Open window technique (a modification of the open technique without removal of the buccal plate). A soft tissue flap is reflected in the usual fashion and the apex area of the tooth fragment is located. A bur is then used to remove the bone overlying the apex of the tooth, exposing the root fragment. An instrument is then inserted into the window, and the root is displaced out of the socket. This approach is especially indicated when the buccal crestal bone must be left intact. An important example is the removal of premolars root tips for orthodontic

purposes, especially in adults. There should be no hesitation to reflect a flap whenever this is necessary to see the retained root clearly. It is also essential to remove adequate bone to enable unimpeded elevation of the fragment along the appropriate line of withdrawal. This will avoid much frustration from repeated premature attempts to dislodge the root.

In the edentulous jaw the incision is made along the crest of the ridge or if adjacent teeth are standing, the incision is made along their gingival margins. The flap must be ample in length and vertical depth in order to provide adequate access for surgical manipulations without damage to the soft tissues.

BONE REMOVAL

What constitutes adequate bone removal can be learned only by experience but, within reason, it is better to remove rather too much bone than too little.

Bone is usually cut away from the buccal aspect of a root because this not only improves the access but brings the fragment into full view. The socket wall can be removed either with a hand chisel or gouge, a mallet and chisel, or a drill.

In general a bur in a dental drill is preferable to a chisel or gouge for the removal of bone around a buried root because if a hammer and chisel are used inexpertly the edge of the chisel may strike the root itself and fracture the root. Furthermore, most conscious patients undergoing surgery under local anesthesia find the sensation produced by a mallet and chisel objectionable.

When using a bur, care must be taken not to damage the adjacent teeth or to cut into the root fragment itself to a degree that fracture when elevation is attempted.

Burs are also used to separate divergent or curved roots. A tapered fissure bur is best for this purpose. Separation of roots with a bur may take longer time than splitting them apart with an osteotome but is more certain. If the roots are shattered by the splitting blow their removal may be made more difficult. What is more important is a space is created between the root ends by the bur cut permitting curved or divergent roots to

move towards one another as they are elevated. If the roots are split apart the split surfaces may still impact against one another as elevation is attempted.

If the operation is performed under a general anesthesia it may be convenient for the operator to use chisels and a mallet instead of a hand piece and bur. Two vertical cuts are made, one on either side or parallel to the side of the root. For the more mesial cut the bevel of the chisel should face distally and for the distal one mesially. This way the remaining bone edges are not crushed. A third cut is made horizontally and joining the other two cuts at a suitable distance from the socket margin so as to expose at least a third of the length of the retained root fragment. The cuts should just penetrate the cortical bone and care should be taken not to damage the adjacent teeth, nor should the chisel strike the root as the third cut is made or it will be fractured. A curved Warwick James elevator is inserted to lever the tooth from the socket.

Alveolar bone may also be conserved during the removal of small apical fragments. Instead of removing the whole length of the lateral wall of the socket to reach the root tip a window is cut in the bone overlying the apical part of the socket and access gained to the root in this way. It may be delivered laterally through the opening or it can be dislodged into the socket and retrieved from this aspect if it is a fresh socket.

THE APPLICATION OF AN ELEVATOR

The configuration of the root and direction in which it must be moved for its delivery will determine the correct site of application of the elevator. Roots may be straight or curved and the only way to establish the shape of a particular root is by radiography. The operator should always try to identify the reason why the root fractured during the original extraction. Was the impediment during the original extraction of the tooth relieved by the fracture leaving a readily removable root or does the obstruction still exist.

Theoretically, an elevator can be applied to any side of a straight root in order to apply the necessary

dislocating force. However, if a root is curved the elevator must engage its convex aspect. If it is applied incorrectly to the concave side of the root it will not displace it from the socket but will produce a further fracture of the fragment.

When dealing with multistoried teeth the roots of which all curve in the same general direction, the elevator may be applied to the convex aspect of the whole root complex. However if the lines of withdrawal of the apices conflict, because of a divergent or curved root pattern, then the roots must be separated before applying an elevator against the convex surface of each in turn. Occasionally the application of an extraction force to unfavorable roots in infected or resilient bone will result in successful delivery without fracture, but in the vast majority of cases, the unorthodox approach will lead to further fragmentation or to crushing of the socket wall and the formation of a dry socket. Even in the absence of a suitable preoperative radiograph, an experienced operator can often feel whether he is applying pressure to the correct aspect of the root, for on sensing the slightest resistance he will alter the position of the instrument so that the edge of the blade engages a more appropriate side of the root. Nevertheless, it is obviously more satisfactory to avoid guesswork, and obtain the relevant information about root pattern from a radiograph. The elevating force should always be modest and controlled as the application of excessive force will result in further fractures of the tooth fragment or even a fracture of the jaw. A fractured jaw is most likely to occur during the removal of deeply embedded roots in a thin mandible. There are times when, after adequate surgical exposure of the socket, a systematic search for the root tip proves abortive. Alternative possibilities for its location should then be considered, namely dislodgement into the soft tissues, deflection into the antrum from upper posterior teeth, displacement into the inferior dental canal or lingual pouch from lower posterior teeth, loss into the mouth or on to the surgery floor. Some patients refuse to have a retained root removed. When this happens the issue should not be

pressed, but an entry should be made in the case notes to this effect.

POLICY FOR LEAVING ROOT (TIP) FRAGMENTS

When a root tip has fractured and the closed approach of removal has been unsuccessful and the open approach may be extensively traumatic, the surgeon may consider leaving the root in place. As with any surgical approach, the surgeon must balance the benefits of surgery against the risks of surgery.

CONDITIONS FOR LEAVING ROOT TIPS IN THE SOCKET

Three conditions must exist for a tooth root to be left in the alveolar process.

1. First the root fragment must be small, usually not more than 4 or 5 mm in length.
2. The root must be deeply embedded in bone and not superficial. This prevents subsequent bone resorption from exposing the root and interfering with the prosthesis that will be constructed over the edentulous area.
3. The tooth involved must not be infected, and there must be no radiolucency around the root apex.

The 3 risks involved on removal of root tips: The risk is considered to be greater than the benefit if one of the following conditions exists.

1. Removal will cause excessive destruction of the bony tissue.
2. Removal of the root endangers the vital structures, most commonly the inferior alveolar nerve, either at the mental foramen area or along the course of the canal. If surgical retrieval of a root may result in a permanent or even a prolonged temporary anesthesia of the inferior alveolar nerve, the surgeon should seriously consider leaving the root tip in place.
3. Attempts at recovering the root tip can displace the root into the tissue spaces or into the maxillary sinus. The roots most often displaced into the maxillary sinus are those of the maxillary molars.

The Root Piece Removal (The Fractured Root)

4. If the preoperative radiograph shows that the bone is thin over the roots of the teeth and that the separation between the teeth and the sinus is small, the surgeon will choose to leave a small root fragment rather than risks displacing it into the maxillary sinus. Likewise, roots of the mandibular second and third molars can be displaced into the submandibular space during attempts to remove them.

ROOTS IN EDENTULOUS JAWS

- Difficult to judge the position of the root piece. There are no teeth. Hence it is difficult to determine the location without any guideline
- Insert a short needle in anesthetized gingiva and take a radiograph just before the operation
- Better to retrieve the root fragment through outer aspect of jaw, rather than alveolar crest to preserve the alveolar height.

PROTOCOL WHEN LEAVING BEHIND THE ROOTS

If the surgeon decides to leave a root tip in place, a strict-protocol must be observed. The patient must be informed that, in the surgeon's judgment, leaving the root in position will do less harm than surgery. In addition, radiographic documentation of the root tips presence and position must be obtained and retained in the patient's record. The fact that the patient was informed of the decision to leave the root tip in position must be recorded in the patient's record. Also the patient must be recalled for several routine periodic follow-ups over the year to trace the fate of this root. The patient should be asked to contact the surgeon immediately if any problems develop in the area of the retained root.

Chapter

DropBooks

Pediatric Exodontia

The general principles of exodontias remain the same whether applied to adults or to children. However, in the child we are dealing with a developing organism in both its physical and its psychological aspects. Techniques, therefore, must be modified to conform to the needs of this growing patient. Some factors to be considered in oral surgery for children as compared to adults are:

1. The oral cavity is small and there is greater difficulty in gaining access to the field of operation.
2. The jaws are in the process of growth and development and the dentition is in a continuous state of change, with the eruption and resorption of primary teeth and eruption of permanent teeth taking place simultaneously. Any interference with the growth centers in the jaw or premature extraction of primary-teeth may lead to malformations of the jaw, the permanent teeth or both.
3. The bone structure of a child contains a higher percentage of organic material, which makes it more pliable than adult bone and not as likely to fracture.

LOCAL ANESTHESIA

It is unfortunate that many practitioners refer children to the oral surgeon for extractions under general anesthesia without first making an effort to perform the extraction themselves under local anesthesia. The general practitioner or pedodontist should instruct parents that general anesthesia is the method of choice.

We have found that many children can be handled under local anesthesia, provided that parents cooperate and there are no other contraindications. The child should be told in simple words what is going to be done. He should never be told an untruth: a child can be disappointed only once and his confidence is lost forever. It is safer to tell the child that he will experience slight discomfort like a scratch or mosquito bite than to promise complete painlessness and not be able to abide by our promise.

If a child complains of pain during an injection or operation, believe him. reconsider the situation, reinject

if necessary, but never submit him to pain by force. A great percentage of even the more difficult and frightened children can be persuaded to take a local anesthetic. When elective surgery is to be done, it is best to see the patient at least once prior to the operation. This gives the operator time to talk to the patient and presents an opportunity to establish rapport. This visit will permit discussion of the procedure with the child and parents. By taking time to explain what needs to be done, the dentist can keep apprehension and fear to a minimum.

PREPARATORY MEASURES

It is mandatory to obtain permission from a parent or guardian of a child before any type of anesthesia, local or general, is to be used. The consent should be in written form and should include the type of anesthesia to be used and the operation to be performed. In an emergency, a telephone call will suffice, but it should be confirmed by a written statement as soon as possible. It is a safe precaution to note the number of the telephone and the name of the person giving the oral consent on the record of the patient, preferably in the presence of an assistant who can act as a witness.

Children seem to tolerate local anesthetics better after a moderate food intake, about two hours prior to the operation. If it is felt that the child might require a general anesthetic, the parents should be told not to give the child food or fluids for at least six hours prior to the procedure.

Appointments for extraction should be made whenever possible in the early morning when the child is well rested. The office appointment should be scheduled so that the child does not have to wait because he tends to become restless.

The instruments on the tray should be covered with a towel and out of sight of the patient. We have found it best to place the instruments on a tray behind the patient. A display of needles, knives, forceps and other instruments upsets not only a child but any patient. There is never a need to load syringes in front of patients; to do so only loads to further fear and apprehension.

Premedication has proven invaluable and an operator should not hesitate to use it. Immediately before the operation, the child should be sent to empty the bladder and bowels whether local or general anesthesia is used.

Clothing should be loosened and protected with a gown or a protective apron. We prefer linen aprons, as rubber or plastic coverings make patients perspire more freely and this makes any patient, including a child, more uncomfortable. Relatives and friends should be sent out of the operating room unless it is felt that their presence may be of benefit in handling the child. The child's position should be adjusted for comfort and support and should be slightly reclining.

ANESTHESIA TECHNIQUE

Some clinicians advise the use of topical anesthetics before injection. It is difficult to determine how effective they are. They certainly have a psychological value, but they do not substitute for a good injection technique. If they are used at all they should be used properly.

1. The mucous membrane should be dried to avoid dilution of the topical anesthetic solution.
2. The topical anesthetic should be held in contact with the surface for at least 2 minutes, allowing at least another minute for it to act. One of the errors made in the use of topical anesthetics is the operator's failure to permit sufficient time for the topical agent to produce any effect before he injects. It is wise to wait at least four minutes after the topical anesthetic is applied before starting the injection.
3. A topical anesthetic should be selected which does not cause local necrosis at the site of application. No irritation has been found from the use of Xylocaine (lidocaine) ointment.
4. A sharp, fine needle with a relatively short bevel should be used, attached to a smoothly working syringe. We feel disposable needles should be used, for they assure both sharpness and sterility. Their use eliminates the possibility of transferring infection from one patient to another by means of a contaminated needle.

5. The tissues should be stretched if loose, as they are in the mucobuccal fold: they should be compressed if densely attached, as they are on the hard palate. The use of tension and pressure helps produce a certain degree of anesthesia and thus lessens the pain associated with the introduction of the needle. If the tissue is loose, we prefer to pull the tissue over the needle as we are advancing it.
6. When using an infiltration technique the anesthetic solution should be deposited slowly. Rapid injection tends to accentuate the pain. If more than one tooth in the maxilla has to be anesthetized, the operator can enter the initially anesthetized area and, by changing the direction of the needle to a more horizontal position, can gradually advance the needle and deposit the anesthetic solution. The palatal side may be anesthetized by injecting a few drops anterior to the greater palatine foramen, which can be found on a line connecting the last erupted upper molars. When anesthesia is necessary in the incisal region of the maxilla we have found it best to give the anesthetic on the labial and then pass the needle from this anesthetized area through the interdental papilla between the centrals and gradually deposit the anesthetic solution as the needle is advanced. This technique seems to produce less pain than if the needle is inserted in or around the incisive papilla.
7. The vasoconstrictor should be kept at the lowest possible concentration e.g., with 2 per cent Xylocaine, not more than **1:100,000** epinephrine should be used.
8. The symptoms of anesthesia should now be explained to the child. Numbness, tingling, a feeling of swelling may otherwise frighten a child who has not been forewarned.
9. Enough time (5 minutes) should be allowed to lapse before any operation is started. If tingling and numbness in the lower lip do not occur in 5 minutes following an inferior dental block, the injection should be considered a failure and repeated.

10. Aspirating syringes should be used to prevent intravascular injection of the anesthetic solution to keep toxic, allergic and hypersensitivity reactions at a minimum.

TYPES AND LOCATION OF INJECTION

In anesthetizing the maxillary primary molars or permanent premolars, the needle should penetrate the mucobuccal fold and be inserted to a depth that approximates that of the apices of the buccal roots of the teeth. The solution should be deposited adjacent to the bone. The maxillary permanent molars may be anesthetized with a posterior superior alveolar nerve block or by local infiltration.

Labial infiltration commonly is used to anesthetize the primary anterior teeth. The needle is inserted in the mucobuccal fold to a depth that approximates that of the apices of the buccal roots of the teeth. Rapid deposition of the solution in this area is contraindicated because it produces discomfort during rapid expansion of the tissue. The innervation of the anterior teeth may arise from the opposite side of the midline. Thus, it may be necessary to deposit some solution adjacent to the apex of the contralateral central incisor.

The infraorbital block injection is an excellent technique that may be used in place of local infiltration of the anterior teeth. All ipsilateral anterior maxillary teeth are anesthetized by this block. The needle is inserted anywhere in the mucobuccal fold from the lateral incisor to the first primary molar and is advanced next to bone to a depth that approximates the infraorbital foramen. The foramen is readily palpated as a notch on the infraorbital rim of the bony orbit. The solution is deposited slowly.

The tissues of the hard palate are innervated by the anterior palatine and nasal palatine nerves. Surgical procedures involving palatal tissues usually require a nasal palatine nerve block or anterior palatine anesthesia. These nerve blocks are painful, and care should be taken to prepare the child adequately. These injections are not

usually required for normal restorative procedures. If it is anticipated that the rubber dam clamp will impinge on the palatal tissue, however, a drop of anesthetic solution should be deposited into the marginal tissue adjacent to the lingual aspect of the tooth. A blanching of the tissue will be observed.

MANDIBULAR TOOTH ANESTHESIA

The inferior alveolar nerve innervates the mandibular primary and permanent teeth. This nerve enters the mandibular foramen on the lingual aspect of the mandible. The position of the foramen changes by remodeling more superiorly from the occlusal plane as the child matures into adulthood. The foramen is at or slightly above the occlusal plane during the period of the primary dentition. In adults, it averages 7 mm above the occlusal plane. The foramen is approximately midway between the anterior and posterior borders of the ramus of the mandible.

For the inferior alveolar nerve block, the child is requested to open his or her mouth as wide as possible. Mouth props may aid in maintaining this position for the child. The ball of the thumb is positioned on the coronoid notch of the anterior border of the ramus, and the fingers are placed on the posterior border of the ramus. The needle is inserted between the internal oblique ridge and the pterygomandibular raphe. The barrel of the syringe overlies the two primary mandibular molars on the opposite side of the arch and parallels the occlusal plane. The needle is advanced until it contacts bone, aspiration is completed, and the solution is deposited slowly. Occasionally, the inferior alveolar nerve block is not successful. A second try may be attempted; however, the needle should be inserted at a level higher than that of the first injection. Care must be taken to prevent an overdose of anesthetic.

The long buccal nerve supplies the molar buccal gingiva and may provide accessory innervation to the teeth. It should be anesthetized along with the inferior alveolar block. A small quantity of solution is deposited

in the mucobuccal fold at a point distal and buccal to the most posterior molar.

Local anesthesia in children does not differ to a great extent from that in adults. The lesser density of bone hastens the diffusion of the local anesthetic through the compact layers of the bone. On the other hand, the smaller size of the jaws reduces the depth to which the needle has to penetrate in certain block anesthesia. One will find that, with the exception of the inferior dental block, no other blocks are necessary in children.

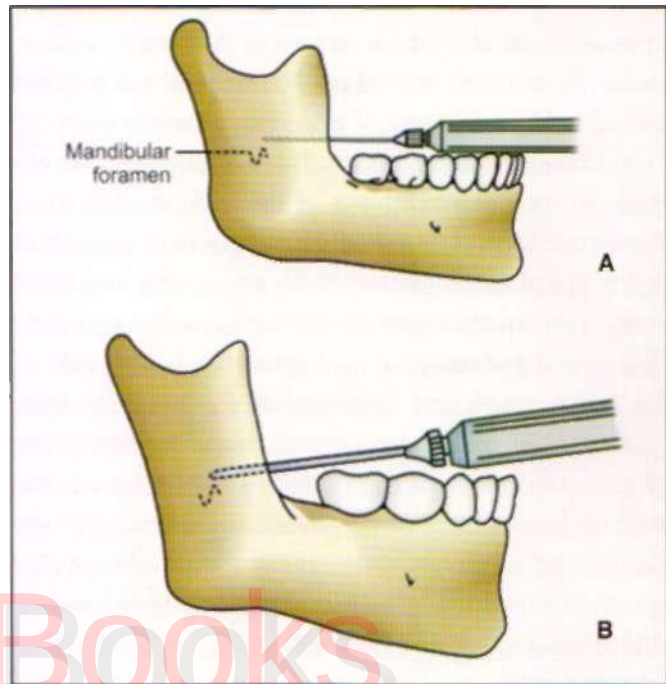
The bone density is such, especially in the region of the tuberosity that anesthetic solutions easily pass through the cortex without the dentist having to a deeper injection. Deep injections in this area may be followed by a hematoma due to injury of the adjacent pterygoid plexus, or, what is more likely, an injury of the posterior superior alveolar artery or of its external gingival branch, which runs downward and forward along the postero-lateral wall of the maxilla close to the periosteum. This is an unpleasant accident but it cannot always be avoided. A hematoma, once noticed, can be controlled by packing tightly compressed sponges behind and lateral to the tuberosity intra-orally while applying pressure from the outside against this pack with ice-cold compresses.

Mental and infraorbital blocks are usually unnecessary. They often lead to transient nerve injuries and hematomas which are painful. The block of the greater palatine foramen often causes a sensation of choking.

In terminal infiltration the puncture is made in the mucobuccal (labial) fold, slightly gingival to the deepest point, and the needle penetrates toward the bone in the direction of the apex of the particular tooth. One should consider the length of the root of each particular tooth as seen on the roentgenogram.

Permanent molars require block injection; so do multiple extractions or larger operations involving the lower jaw. In making an inferior nerve block injection, one has to bear in mind that the ascending ramus in the child is shorter and narrower anteroposteriorly than

in the adult. The anteroposterior width may be estimated by palpation through the skin. The lesser height of the ramus has to be compensated for by inserting the needle a few millimeters nearer to the occlusal plane than in adults (Figures 9.1 A and B).



Figures 9.1A and B: Difference in inferior alveolar nerve block techniques

As mentioned earlier, the child should be informed of the subjective signs such as tingling, numbness and a feeling of swelling in the lip and tongue, either before or preferably after the anesthesia has been administered. Testing for anesthesia should be done carefully with slowly increasing pressure of an explorer or other instrument, keeping in mind that anesthesia in the superficial tissues does not necessarily mean anesthesia of the deeper tissues.

The long buccal nerve should not be anesthetized until definite signs of numbness in the respective side of the lip appear, as the child might give misleading information because he is confused by the tingling or numbness of the mucosa of the lip. The long buccal nerve should be anesthetized by terminal infiltration in the mucobuccal fold of the respective tooth.

Exodontia Practice

EXTRACTION OF PRIMARY TEETH

INDICATIONS

In considering the advisability of extraction of primary teeth, one should always keep in mind that age per se is not an acceptable criterion in determining whether a primary tooth should be removed. A primary second molar, for example, should not be removed just because a child is 11 or 12 years of age. unless there is a special indication. For some patients the second premolars are ready to erupt at 8 or 9 years of age while in other cases these same teeth do not show sufficient root development at the age of 12. A primary tooth that is firm and intact in the arch should never be removed unless a complete clinical and radiographic evaluation has been made of the entire mouth and especially of the particular area.

Occlusion, arch development, size of teeth, amount of root, resorption of the primary tooth involved, the state of development of the underlying permanent successor and adjacent teeth, presence or absence of infection all of these factors must be considered in determining when and how a primary tooth should be removed.

With the above considerations in mind, indications for extraction of primary teeth are as follows:

1. If the teeth are decayed beyond possible repair; if decay reaches down into the bifurcation or if a sound hard gingival margin cannot be established.
2. If infection of the periapical or interradicular area has occurred and cannot be eradicated by other means.
3. In cases of acute dentoalveolar abscess with cellulitis.
4. If the teeth are interfering with the normal eruption of the succeeding permanent teeth.
5. In cases of submerged teeth.

CONTRAINDICATIONS

Contraindications to extraction, except for the considerations mentioned above, are more or less the same as in adults. Many of these contraindications are relative and may be overcome with special precaution and premedication.

1. *Acute infectious stomatitis, acute Vincent's infection or herpetic stomatitis*, and similar lesions should be eliminated before an extraction is contemplated. Exceptions to this are conditions such as acute dentoalveolar abscesses with cellulitis, which demand immediate extraction.
2. *Blood dyscrasias* render the patient susceptible to postoperative infection and hemorrhage. Extractions should be performed only after adequate consultation with a hematologist and proper preparation of the patient.
3. *Acute or chronic rheumatic heart disease, congenital heart disease* and kidney disease require proper antibiotic coverage.
4. *Acute pericementitis, dentoalveolar abscesses and cellulitis* should be treated as will be explained later, when and if indicated, with preoperative and postoperative antibiotic medication.
5. *Acute systemic infections* of childhood contraindicate elective extractions for the child because of a lowered resistance of the body and the possibility of secondary infection.
6. *Malignancy*, if suspected, contraindicates dental extractions. The trauma of extraction tends to enhance the speed of the growth and spread of tumors. On the other hand, extractions are strongly indicated if the jaw or surrounding tissues are to receive radiation therapy for malignancy: this is done to avoid the risk of an infection in the bone which has been exposed to radiation.
7. *Teeth which have remained in irradiated bone* should be extracted only as a last resort and only after the consequences have been fully explained to the parents. If the teeth must be removed, consultation with the radiologist who gave the irradiation might be wise. Infection of the bone will follow extractions in most cases even after antibiotic therapy, owing to the avascularity which follows the radiation. The infection is followed by a slowly progressing osteomyelitis which is very painful and which cannot be controlled except by wide resection of the whole

irradiated bone. It is, therefore, very dangerous to remove teeth after exposure to radiation.

8. *Diabetes mellitus* poses a relative contraindication. Consultation with the physician is a wise precaution to make certain that the child is under control. In controlled cases of diabetes, one does not observe more infections than in normal children and therefore antibiotics are not a prerequisite to extraction. It is important that the diabetic child retain his diet in the same qualitative and quantitative composition after an operation. Changes in these respects may change the sugar and fat metabolism of the child.

INDICATIONS FOR EXTRACTION OF PERMANENT FIRST MOLARS

When making a decision about the fate of permanent first molars, the following considerations should be kept in mind. If a permanent first molar is removed before the permanent second molar has erupted through the gingiva, the chances that this second molar will move mesially and occupy the space of the extracted first molar are very good. If, on the other hand, the permanent second molar has erupted through the gingiva at the time of the loss of the permanent first molar, the second molar will probably tilt forward into the space of the first molar, causing conditions favoring periodontal disease and orthodontic problems such as closing-of the bite.

The procedure in practice, therefore, should follow the rule that when the second molar has not yet broken through and one or two first molars are diseased beyond repair, they should be removed. But if three first molars are diseased beyond repair, all four first molars should be removed with the expectation that a more symmetrical dentition will result.

In cases in which the second molars have broken through, every attempt should be made to save the first molars. If extraction is necessary, only the destroyed teeth should be removed and space maintainers should be inserted.

EXTRACTION TECHNIQUE FOR PRIMARY TEETH

Armamentarium

Many dentists choose to use the same surgical instruments for their child patients as they routinely use for their adult patients. Most pediatric dentists and oral and maxillofacial surgeons, however, prefer the smaller pediatric extraction forceps, for the following reasons:

1. Their reduced size more easily allows placement in the smaller oral cavity of the child patient.
2. The smaller pediatric forceps are more easily concealed by the operator's hand.
3. The smaller working ends (beaks) more closely adapt to the anatomy of the primary teeth.

The choice of the proper instrumentation can also depend on special considerations unique to the child and the adolescent. The use of cow horn mandibular forcep is contraindicated for primary teeth, owing to the potential for injury to the developing premolars. Great care must also be given to the routine use of elevators and forceps adjacent to large restorations such as metal crowns and especially restorations adjacent to erupting single-rooted teeth that may easily become dislodged with the slightest force (Figures 9.2A and B).



Figures 9.2A and B: Pediatric extraction forceps

General Considerations

The technique used to perform extractions in the child patient is similar to the manual extraction technique used in the adult. The greatest difference is in patient management. It is essential that the dentist take the time to describe the ensuing procedure completely and accurately to the child. A few children require general anesthesia for the surgical procedure to be accomplished. The choice of proper local anesthesia-sedation-general anesthesia technique depends on the psychological constitution of the child and the extent and nature of the surgical procedure. The appropriate local anesthetic technique for each type of tooth is described earlier in this chapter.

A number of aspects of the extraction procedure should be performed with every extraction. The dentist should consult with the child and the parents prior to surgery in order to prepare them for the upcoming procedure. The dentist should provide any preoperative needs, such as prescriptions or any dietary restrictions, that might be necessary as a result of the planned sedative techniques. The entire surgical procedure and the expected postoperative recovery course should also be described. This allows the parents to prepare for any special postoperative arrangements, such as the need for a soft diet or child care support. As noted before, the dentist should perform a thorough review of the patient's medical history, looking especially for medical conditions that might complicate treatment.

There is no other type of dental treatment in which the principles of tell, show, and do are more important than during extractions. The dentist should be sure to obtain profound anesthesia because once the patient has felt pain, it may be difficult to regain the child's confidence to a level in which he or she will behave in a manner that allows completion of the procedure.

Just prior to the actual extraction, the dentist should place the balls of the index finger and thumb in the area of the extraction and demonstrate to the child the types of pressures and movements that he or she will encounter during the extraction. This digital pressure

should be firm enough to rock the child's head from side to side in the headrest.

The dentist should be placed in the position in which he or she can easily control the instrumentation, have good visual access to the surgical site, and control the child's head. The non-dominant hand of the dentist is then placed in the patient's mouth. The role of the nondominant hand is to help control the patient's head: to support the jaw being treated; to help retract the cheek, lips, and tongue from the surgical field; and to palpate the alveolar process and adjacent teeth during the extraction. Once the proper operator and nondominant hand positions are established, the actual extraction technique may begin. Variations in technique for individual teeth are discussed later in this chapter, but the general principles apply to all extractions are same.

After the tooth is removed from its socket, the surgical site is evaluated visually and with the use of a curette. The curette should be used as an extension of the dentist's finger to palpate and evaluate the extraction site. No attempt should be made to scrape the extraction site. If a pathologic lesion such as a cyst or periapical granuloma is present at the apex of a permanent tooth socket, it should be gently enucleated. Aggressive manipulation of a curette in a primary tooth socket is contraindicated owing to the potential for damage to the succeeding tooth bud. The operator should palpate both the facial and palatal or buccal and lingual aspects of the surgical site to feel for any bone irregularities or alveolar expansion. Any bone sharpness should be conservatively removed with the use of either a rongeur or a bone file. Digital pressure should be able to return the alveolus to its presurgical configuration if gross expansion has occurred.

MAXILLARY MOLAR EXTRACTIONS

Primary maxillary molars differ from their permanent counterparts in that the height of contour is closer to the cemento-enamel junction and their roots tend to be more divergent and smaller in diameter. Because of the root structure and potential weakening of the roots during

the eruption of the permanent tooth, root fracture in primary maxillary molars is not uncommon.

The extraction is completed using a maxillary universal forceps. Palatal movement is initiated first, followed by alternating buccal and palatal motions with slow continuous force applied to the forceps. This allows expansion of the alveolar bone so that the primary molar with its divergent roots can be extracted without fracture.

EXTRACTION OF MAXILLARY ANTERIOR TEETH

The maxillary primary and permanent central incisors, lateral incisors, and canines all have single roots that are usually conical. This makes them much less likely to fracture and allows for more rotational movement during extraction than is possible with multirrooted teeth.

MANDIBULAR MOLAR EXTRACTIONS

When extracting mandibular molars, the dentist must give special care to the support of the mandible with the nonextraction hand so that no injury to the temporomandibular joints is inflicted. The mandibular forceps are used to extract the tooth with the same alternating buccal and palatal motions used to extract maxillary primary molars.

EXTRACTION OF MANDIBULAR ANTERIOR TEETH

The mandibular incisors, canines, and premolars are all single-rooted. Because of this fact, one must take great care that the forceps do not place any force on adjacent teeth because they can become easily dislodged. This also enables the dentist to use rotational movements in the extraction process. Then slow, continuous force applied in alternating labial and lingual movements enables these teeth to be removed easily.

MANAGEMENT OF FRACTURED PRIMARY TOOTH ROOTS

Any dentist who extracts deciduous molars occasionally has the opportunity to treat root fractures. Once the root

has fractured, the dentist must consider the following factors. Aggressive surgical removal of all root tips may cause damage to the permanent tooth buds. On the other hand, leaving the root may increase the chance for postoperative infection and may increase the theoretical potential of delaying permanent tooth eruption, although most primary root tips will resorb. A common-sense approach is best. If the tooth root is clearly visible and can be removed easily with an elevator or root tip pick, the root should be removed. If several attempts fail or if the root tip is very small or is situated very deep within the alveolus, the root is best left to be resorbed, most probably by the erupting permanent tooth. In some cases, the root tips do not resorb but are situated mesially and distally to the succeeding premolar and do not impede its eruption. The patient and parents should be notified that a root fragment has been retained, and they should be assured that the chance of unfavorable sequelae is remote.

If the preoperative evaluation indicates that a root fracture is likely or that the developing succedaneous tooth may be dislodged during the extraction, an alternative extraction technique should be used. In these cases, the crown should be sectioned with a fissure bur in a buccolingual direction so that the detached portions of the crown and roots can be elevated separately.

If sufficient resorption of the roots has occurred, extractions may be very simple. On the other hand, if a tooth, especially a molar, has to be removed prematurely, the roots may have undergone little or irregular resorption, and this situation can make these extractions difficult. It must be borne in mind that the crown of the succeeding tooth is situated in close relationship to the roots of the primary tooth. The widespread roots of the primary molars surround the crowns of the permanent teeth, and we may dislodge, if not extract, the forming tooth if great care is not exercised during the extraction. The permanent tooth will offer little opposition because of the lack of development of its roots. Not infrequently the resorption of a primary molar root occurs halfway between the apex and the cemento-enamel junction.

This weakens the root considerably and fractures of such roots are not uncommon. Good radiographs are of great importance and should be studied carefully before the extraction is planned. If such a root is broken, the question arises whether it should be removed immediately or whether an attitude of watchful waiting should be taken. The decision hinges upon the skill of the operator and the accessibility of the root tip. If the tip can be removed without trauma to the bud of the permanent tooth, it should be elevated with small spear-point elevators. Occasionally it is desirable to elevate a mucoperiosteal flap and remove buccal bone to approach such a tip. The commercial elevators are usually too heavy and large. We prefer an instrument which has been ground into a point from a straight root tip elevator.

If a permanent tooth bud is *moved* during an

extraction, it should be carefully pushed into its original position and the socket closed with one or two sutures. Some operators cover the bud with Gelfoam. Should a permanent tooth bud be erroneously extracted, it should be reinserted immediately without disturbing the tooth follicle or dentinal papilla. Care should be taken to orient the tooth in the socket in the proper buccolingual position, and the socket should be closed by sutures. Pulp tests should be made of the tooth after eruption.

If an already erupted permanent tooth with an insufficiently formed root has been dislodged during the removal of a primary tooth, it should be reinserted and immediately splinted. After healing, pulp tests should be made, although the radiographic findings of further root development and of eventual narrowing of the root canal are proof that the vascular supply has been reestablished.

Chapter

Exodontia for Medically Compromised Patients

10

Exodontia Practice

Exodontia is a minor procedure that can be safely performed in dental office provided the patient is healthy and the procedure is not dramatically invasive. It might require some special attention in situation where the host is compromised either due to underlying systemic disease or certain prevailing condition like pregnancy, which render them susceptible to complications. Knowledge regarding the patient's medical condition is of utmost importance in patient management. One should always keep the following words in mind "*Dentist should not be concerned only with the treatment of teeth in patients but also the treatment of patients who have teeth*". Good pre-operative assessment endeavors to anticipate and prevent trouble. Hence before any extraction it is a clever practice to take a thorough medical history and it is truly said time spent in taking thorough history is never wasted. Certain systemic conditions needs special mention like cardiac diseases (e.g. Hypertension), respiratory disorders (e.g. asthma), endocrine disorders (e.g. Diabetes mellitus. thyroid dysfunction), disorders of hemostasis (e.g. hemophilia, thrombocytopenia) patients on long-term steroids, antiplatelets, anticoagulant drugs, pregnancy, etc. Exodontia can be relatively or strictly contraindicated in such systemic conditions. Criteria of fitness for a procedure are not absolute but depends on factors such as the. type of procedure, duration of procedure, degree of trauma and stress, health of patient, degree of urgency of the procedure, skill of the operator, etc. Although care of the medically compromised patient is a complex problem requiring specialties in the field, its occurrence is so common that the practitioners and students must be acquainted with these condition in order to have the competence necessary to recognize and prevent problems associated with exodontia. In this chapter the commonly encountered systemic conditions, preoperative assessment and relevant investigations to be performed, special precautions to be taken pertaining to extraction of teeth, anesthetic considerations, careful use of drugs and indication, contraindications if any are discussed.

List of condition commonly encountered and needs special mention.

- Diabetes
- Hypertension
- Infective endocarditis
- Heart failure
- Artificial valves/transplants
- Thyroid dysfunction
 - Hyperthyroidism
 - Hypothyroidism
- Disorders of hemostasis
 - Hemophilia.
 - Patients on anticoagulants, antiplatelet drugs.
- Patients on long-term steroids.
- Pregnancy
- Epilepsy
- Asthma
- Patients undergoing radiotherapy

DIABETES

Diabetes mellitus is a group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. There can be a low output of insulin from the pancreatic beta cells, or the peripheral tissue may resist insulin. Types of diabetes includes insulin dependent (type I immune mediated or idiopathic) and non-insulin dependent (type II), Gestational diabetes mellitus. Other specific types include, Genetic defects in beta cell function. Genetic defect in insulin action, diseases of exocrine pancreas, endocrinopathies. drug induced infectious associated with other genetic syndromes.

Type I diabetes is the result of progressive destruction of the beta cells in the islets of Langerhans. which leads to severe insulin deficiency. Symptoms of diabetes become apparent when approximately 80-85% of the beta cells are destroyed. Develops most often in children and young adults before the age of 25 years.

The etiology of *type II* diabetes is not established. The principle underlying defects are insulin resistance i.e. the reduction in biological effect of insulin on glucose

metabolism, beta cell failure which includes delayed insulin secretion after nutrient stimulation, inability to compensate for insulin resistance, metabolic inhibition of beta cell function by chronic hyperglycemia.

Clinical features of diabetes can be divided into early and late. Early features usually includes confusion and behavioral change, constipation, itching, increased thirst and urination (polydipsia and polyuria), polyphagia, unexplained weight loss, undue tiredness, tingling or numbness in the extremities, burning feet. Late features include abdominal pain, coma, dehydration, hyperventilation, muscle wasting, nausea, paraesthesia, renal failure, shock, vomiting.

Laboratory diagnosis can give some definite clue, a person can be said as having diabetes if there are symptoms of diabetes and random plasma glucose concentration ≥ 200 mg/dl. Fasting plasma glucose ≥ 126 mg/dl, 2 hours plasma glucose ≥ 200 mg/dl during glucose tolerance test.

Complications of diabetes can be varied and classified as acute and chronic. Acute complication include mainly hypoglycemia and hyperglycemia. Hypoglycemia is seen usually in patients treated with insulin and is due to imbalance between food intake and insulin therapy. Hypoglycemic coma is the main acute complication. It is usually of rapid onset and is usually a result of failure to take food, overdose of insulin, alcohol consumption. Hyperglycemic coma is usually has a slow onset over many hours with deepening drowsiness, signs of dehydration, acidosis. Long standing diabetes can lead to a variety of complication. Chronic complication of diabetes mainly includes large blood vessel disease, small vessel disease (microangiopathy) and increased susceptibility to infection.

Diabetics are considered to be at increased risk of preoperative morbidity and mortality because of the involvement of their vital organs the autonomic nervous system in the natural course of the disease. Poor metabolic control results in dangerous acute metabolic complications due to surgical stress. The infection that develops in them tends to become virulent which further

worsens the metabolic state, thus establishing a vicious cycle.

Hyperglycemia leads to impaired wound healing, deficient formation of granulation tissue, with poor tensile strength of collagen. The fibroblast formation takes longer time than non-diabetics and there is a deficient capillary-growth into the wound. The chemotactic, phagocytic and bactericidal activity of the neutrophil is deficient. There is impaired humoral host defense mechanism and abnormal complement function. Hence metabolic assessment and management of diabetes must begin early and maintenance of euglycemia (atleast < 200 mg%) during peri-operative period will reduce the morbidity and mortality to a very large extent.

Surgical procedure causes a considerable metabolic stress in the non-diabetic and more so in a diabetic. The stress response to surgery is mediated by neuroendocrine system essentially by stimulating the adreno-medullary axis. The neuroendocrine system comes into play to maintain fuel requirements by glycogenolysis and gluconeogenesis through stress hormones catecholamines, glucagon, Cortisol, and growth hormone. In a non-diabetic there is enough insulin secretion to utilize the fuel produced by the stress hormones and thus glucose homeostasis is maintained. Whereas this compensatory elaboration of insulin is less possible in Type II diabetic and cannot occur in Type I diabetic necessitating supplementation of insulin in peri-operative period.

The pre-operative evaluation is necessary to know the metabolic, nutritional, electrolyte, cardiac, pulmonary and renal functions as well as the autonomic and peripheral nervous system status. If the cardiac disease is suggested by history and physical examination, the tests to detect the presence of ischemic heart disease can be helpful in preoperative assessment of the patient.

CARE PERTINENT TO EXODONTIA

Exodontia is a minor surgical procedure and is usually elective unless performed in emergency depending on the merit of individual case. It is important to determine disease status, associated disorders and drug therapy.

Physician consent should be obtained regarding the planned surgical procedure including drug administration. Before performing any kind of procedure the dentist should make use of stress reduction protocol. Stress increases the amount of secreted Cortisol and endogenous epinephrine which induces hyperglycemia. So the procedure should be short, stress free and atraumatic. Once every measure to reduce the anxiety of patient is made, other most important concern is avoiding hypoglycemia. Additional consideration should be given to maintenance of normal dietary habits. Exodontia can interfere with normal pattern of food intake and can interfere with diabetic control, so the insulin dosage must be adjusted accordingly. It is best to give oral glucose just before appointment. The essential requirement is to avoid hypoglycemia but to keep hyperglycemia below levels that may be harmful because of delayed wound healing or phagocytic dysfunction.

Appointments should be early to mid-morning after a normal breakfast and normal antidiabetic treatment because levels of endogenous corticosteroids are higher in morning and stressful procedure are tolerated better. Antibiotic prophylaxis varies depending on the state of patient's metabolic control. Prophylactic antibiotic coverage is indicated because of following reasons like defective leukocyte function, decreased chemotaxis and phagocytosis secondary to hypoglycemia, decreased bactericidal activity, cellular immunity and vascular stasis, higher infection rates and impaired healing. Local anesthesia can be used safely. Epinephrine level in local anesthesia has no significant effect on blood sugar but excessive quantities of epinephrine should be avoided to prevent elevation of blood glucose levels by stimulation of sympathetic receptor system. Conscious sedation can be used safely as well. Autonomic neuropathy in diabetes can cause orthostatic hypertension hence supine position should be slowly raised upright in the dental chair.

SYSTEMIC HYPERTENSION

Hypertension is a persistently raised blood pressure resulting from raised peripheral arteriolar resistance, but

the definition of in terms of blood pressure, of what is hypertension is arbitrary. In general the blood pressure rises with age. When either or both systolic or diastolic pressure are persistently raised and on remeasurement with systolic pressure over 140 and diastolic over 90 mmHg, it is generally regarded as hypertension. About one-third of the people with hypertension are unaware of it, and those under treatment only one-third are fully compliant. In more than 90% the cause is unknown and it is then termed essential hypertension which becomes more frequent as the age advances, and appears to be related to genetic influence, obesity and various other factors. About 40% of hypertensive patients have raised levels of circulating catecholamines, epinephrine or nor-epinephrine and may therefore have abnormal sympathetic activity. Hypertension can be secondary to defined causes such as renal disease, endocrine disorders, pregnancy, oral contraceptives, certain drugs like cocaine, amphetamine, immunosuppressives, glucocorticoids, mineralocorticoids, etc. can raise the blood pressure. Some nonsteroidal anti-inflammatory drugs like indomethacin can impair the efficacy of the antihypertensive agents.

CARE PERTINENT TO EXODONTIA

It is important to determine status of hypertension, associated disorders and physician's consent of any planned surgical treatment regimen. Knowledge of drugs administered with their potential to interact with vasoconstrictors, other drug regimens and associated systemic disorders. Implement strict stress reduction protocol. Small, late morning appointments are preferred, as endogenous epinephrine levels peak during morning hours and adverse cardiac events are most likely in the early morning.

Compliance and effectiveness of the medical therapy should be confirmed by blood pressure recordings (average of 2 recordings) at several short appointments prior to and at the time of surgery. Patients with a sustained blood pressure > 160/95 mm Hg are not considered well controlled and exodontia should be delayed until medical control is established.

A risk in the administration of local anesthesia for the hypertensive patient is the inclusion of epinephrine and its sympathomimetic effect on cardiac beta-2 receptors. The current dosages of a local anesthetic solution for a patient with poorly controlled hypertension is two 1.8 ml cartridges (for a total dose of 3.6 ml) with 1:100,000 epinephrine per appointment. If lengthy procedures are anticipated, the epinephrine should be diluted to as ratio of 1:200,000. The side effects of absorbed epinephrine must be weighed against the benefits. Many clinical situations will contraindicate the use of epinephrine. The apprehensive sweating, or nervous patient likely has increased levels of endogenous epinephrine. Because plasma levels of epinephrine are dose dependent, administration of epinephrine would be contraindicated for hypertensive patient. The type of injection that is administered (block vs. infiltration) as well as vascularity of the area where the local anesthetic is being deposited is also an important factor.

Barbiturates, narcotics and phenylephrine are contraindicated in patients on mono-amine oxidase inhibitors.

INFECTIVE ENDOCARDITIS

Infective endocarditis is a rare but dangerous, potentially lethal infection, predominantly affecting heart valves. Platelets and fibrin deposits accumulate at sites where there is turbulent blood flow over damaged valves (nonbacterial thrombotic endocarditis). These sterile vegetations can thereafter readily be infected during bacteremias resulting in infective endocarditis. Infective endocarditis results from two main predisposing factors—bacteremia and a cardiac lesion where there is turbulent blood flow. *Viridans streptococci* such as *Strep. mutans* and *Strep. sanguis* are most common causative organisms. Others implicated include particularly *Staphylococcus aureus* and enterococci. *Viridans streptococci* have complex attachment mechanisms, which may enable them to adhere to the endocardium.

The most common type of bacteremia implicated in patients with infective endocarditis involves *Viridans streptococci*, which are present in enormous numbers in the mouth. *Viridans streptococci* proliferate where oral hygiene is lacking and proliferate into the blood stream in large numbers particularly in during tooth extraction. Oral bacteremia after a tooth extraction are generally transient and last for less than 15 min. but may last even for one hour.

The signs and symptoms are highly variable. In the previously healthy patient who acquires endocarditis due to *Viridans streptococci* the picture is likely to be that. 3 or 4 weeks after a dental operation, there is insidious onset of the low fever and mild malaise pallor or light pigmentation of the skin, joint pains and hepatosplenomegaly. The main effect of endocarditis are progressive heart damage, infection or embolic damage of many organs, especially the kidneys. Release of emboli can have effects ranging from loss of a peripheral pulse to sudden death from stroke. Embolic phenomenon include hematuria, cerebrovascular occlusion, petechiae, purpura of skin and mucous membrane, splinter hemorrhage under the fingernails. Roth spots are small retinal hemorrhages: Osier's nodes are small tender vasculitic lesions of the skin.

CARE PERTINENT TO EXTRACTION

Prophylaxis should be given for dental procedures that disturb the bacteria in periodontal sockets, since this provides a good chance of precipitating infective endocarditis in a susceptible patient (Table 10.1). In a survey of nearly 5000 cases of infective endocarditis attributable to dental treatment, it was found to have followed dental extractions in 95%. Role of antibiotic prophylaxis is a subject of controversy but a word of caution is that antibiotic prophylaxis is essential, where appropriate. The current recommendations are, therefore, that antibiotic prophylaxis is mandatory for extraction. The surgical procedure should be minimally invasive and atraumatic as far as possible.

Exodontia Practice

Table 10.1: Possible prophylactic antibiotic regimens against infective endocarditis

Recommending authority		Regimen
UK: British Society for Antimicrobial Chemotherapy	1992	(a) Amoxicillin: 3g 1 h before treatment
		(b) Clindamycin: 600 mg 1 h before treatment
European consensus	1995	(a) Amoxicillin: 3 g 1 h before treatment
		(b) Clindamycin: 300-600 mg 1 h before treatment
American Heart Association	1997	(a) Amoxicillin: 2 g 1 h before treatment
		(b) Clindamycin: 600 mg 1 h before treatment

HEART FAILURE

Heart failure is when the pumping action of the heart is insufficient to meet body's demands. Lack of tissue and organ perfusion results. The most common cause of heart failure is ischemic heart disease. Left-sided heart failure results in damming of blood back from the left ventricle to the pulmonary circulation with pulmonary hypertension and pulmonary edema. Lying down worsens pulmonary congestion, edema and dyspnea (orthopnea). It also makes respiration less efficient, and cyanosis likely, because the abdominal viscera move the diaphragm higher and reduce the vital capacity of the lungs. Coughing is another typical consequence. The sputum is frothy and, in severe cases, pink with blood. In the more advanced stages of left-sided heart failure there is inadequate cerebral oxygenation, leading to symptoms such as loss of concentration, restlessness and irritability or, in the elderly, disorientation. Right-sided heart failure causes mainly congestion of the systemic and portal venous systems, affecting primarily the liver, gastrointestinal tract, kidneys and subcutaneous tissues. It thus presents with peripheral (dependent) edema and fatigue. The liver is usually enlarged due to passive congestion, causing abdominal discomfort and, in severe cardiac failure, raised portal venous pressure also leads to escape of large amounts of fluid into the peritoneal cavity (ascites). Most patients suffer bi-ventricular failure, since failure of one side of the heart usually leads to failure of the other. The pulse may become rapid and

irregular, particularly if there is atrial fibrillation, and, in extreme cases, patients are cyanotic, polycythemic, dyspneic at rest and edematous with pulmonary edema and distension of neck veins -(raised jugular venous pressure). Heart failure is usually progressive, but may cause few symptoms until activity becomes limited with breathlessness (dyspnea), cyanosis and dependent edema (usually swollen ankles). Sacral or ankle edema are common dysrhythmias and sudden death may result.

CARE PERTINENT TO EXTRACTION

It is dangerous to lay any patient with left-sided heart failure supine. It will severely worsen dyspnea. The dental chair should be kept in a partially reclining or erect position. Extraction may precipitate dysrhythmias, angina or heart failure. Anxiety must be minimized and pain control must be fully effective. For patients with poorly controlled or uncontrolled cardiac failure (worsening dyspnea with minimal exertion, dyspnea at rest, or nocturnal angina), medical attention should be obtained before any dental treatment. Appointments should be short. Patients are best treated in the late morning. Endogenous epinephrine levels peak during morning hours and cardiac complications are most likely in the early morning. Late morning appointments are recommended. An aspirating syringe should be used to give a local anesthetic. Epinephrine may, theoretically, increase hypertension and precipitate dysrhythmias. Blood pressure tends to rise during oral surgery under local anesthesia, and epinephrine can theoretically contribute, but this is usually of little 'practical importance'. Effective analgesia must be provided. Bupivacaine should be avoided as it is cardiotoxic. Otherwise, local anesthesia can usually safely be used providing that consideration is given to the underlying cause of the cardiac failure. Epinephrine containing local anesthetics should not be given in large doses to patients taking beta blockers. Interactions between epinephrine and the beta blocker may induce hypertension if excessive doses of the local anesthetic are given.

Exodontia for Medically Compromised Patients

Supplemental oxygen should be readily available. Cardiac monitoring may be desirable.

Medication such as diuretics may cause orthostatic hypotension, and therefore patients should be raised slowly to the upright position. NSAIDs other than aspirin should be avoided in those patients taking ACE inhibitors since they increase the risk of renal damage. Patients being treated with digoxin for atrial fibrillation or congestive heart failure are more prone to ECG changes such as ST segment depression during dental extractions under local anesthesia than other cardiac patients. Erythromycin and tetracycline should be avoided as they may induce digitalis toxicity by impairing gut flora metabolism of the digitalis. Some drugs may complicate treatment, such as digitalis (vomiting). ACE inhibitors (coughing) or itraconazole (cardiac failure). Conscious sedation can usually safely be used. However, consideration must be given to the underlying cause of the cardiac failure.

ARTIFICIAL HEART VALVES AND TRANSPLANTS

Currently used prosthetic heart valves (synthetic or porcine) are composed of teflon or teflon like material to diminish the possibility of adhesions. The danger of clumps of bacterial colonies collecting on these valves increases after a bacteremia induced secondary to dental procedures. So such patients are highly susceptible to endocarditis, therefore physician's consult for antibiotic pre-medication is important. The management challenge is most difficult because of the need to avoid altering the cardiac output and the physiologic or pharmacologic compensation mechanisms.

TREATMENT CONSIDERATIONS

Patients who have received a mechanical or bio-prosthetic artificial heart valve are at high-risk for endocarditis. The overall risk for prosthetic valve endocarditis is 1-2% per patient year. Infections due to it are of 2 types that occurring early within 2 months of valve replacement which is caused by Staphylococci. Streptococci and gram negative bacilli. Other occurring late, i.e. 2 months of valve replacement, caused by Streptococci

predominantly, antimicrobial prophylaxis is mandatory in these patients. Such patients are maintained on life-long immunosuppressive therapy which creates an increased potential for infection. Steroids suppress the adrenal glands and supplemental corticosteroid therapy is necessary. When the patient is stable post-operatively, the condition and recent history must be assessed to determine if urgent dental care only should be provided in the first 6 months with necessary antibiotics, monitoring, concern for coagulopathies and adrenal suppression.

After 6 months, if the patient is stable, the evaluation of the patient's recent history and medical consultation should reveal what dental extraction is generally possible with considerations for adrenal suppression and the potential for infection owing to immunosuppression.

A significant increase in heart rate is observed in such patients after administration of 2% lidocaine with 1:80,000 epinephrine, but not after the administration of 3% mepivacaine with 1:100,000 epinephrine and prilocaine with felypressin. This suggests that without, or with, low concentrations of epinephrine should be used. Such patients should receive antibiotic premedication orally parenterally. Local (topical) measures for hemostasis should be used.

Lab investigation should be carefully evaluated. PT and aPTT should be adjusted to within 150 % of the normal/control value, i.e. 11 and 35 sec. respectively. BT should be under normal range.

HYPERTHYROIDISM

Hyperthyroidism is associated usually, with a diffuse goiter due to autoimmune disease (Graves disease, primary hyperthyroidism) when there are thyroid-stimulating autoantibodies against thyroid TSH receptor (TRAbs) and thyroid microsomal antibodies (TMABs) sometimes, with a hyperfunctioning (toxic) multinodular goiter or nodule due to one or more thyroid adenomas producing excess thyroxine. 90% of the swellings are benign rarely with thyroiditis, thyroid hormone overdosage, or ectopic thyroid tissue.

Clinical features include anorexia, vomiting or diarrhea, weight loss, anxiety and tremor sweating and heat intolerance cardiac disturbances, particularly in elder patients. These includes tachycardia, dysrhythmias (especially atrial fibrillation) or cardiac failure exophthalmos, eyelid lag and eyelid retraction. Thyrotoxic periodic paralysis comprises attacks of mild to severe weakness, during which serum potassium levels are generally low. Myasthenia gravis may occasionally be associated.

CARE PERTINENT TO EXTRACTION

Patients with untreated hyperthyroidism can be difficult to deal with as a result of heightened anxiety irritability. The sympathetic overactivity may lead to fainting. Local anesthesia is the main means of pain control. The risk from epinephrine exacerbating symphathetic overactivity is only theoretical. Conscious sedation is frequently desirable to control excessive anxiety. Benzodiazepines may potentiate antithyroid drugs, and therefore nitrous oxide, which is morerapidly controllable, is probably safer. Povidone-iodine and similar compounds are best avoided. Carbimazole occasionally causes agranulocytosis, which may cause oral or oropharyngeal ulceration. Otherwise the treated thyrotoxic patient presents no special problems in dental treatment. However, after treatment of hyperthyroidism the patient is at risk from hypothyroidism, which may pass unrecognized.

HYPOTHYROIDISM

Hypothyroidism may be primary (due to thyroid disease) or secondary (to hypothalamic or pituitary dysfunction). The common causes of hypothyroidism are thyroid loss from surgical removal of too much thyroid tissue in a previously hyperthyroid patient or destruction by irradiation of the neck or thyroid gland autoimmune disease (Hashimoto's thyroiditis), associated with autoantibodies to thyroglobulin and thyroid microsomes.

Clinical features includes weight gain, lassitude, dry skin, myxoedema. loss of hair, cardiac failure or ischemic heart disease, bradycardia, anemia, neurological or

psychiatric changes, hypotonia, cerebellar signs of ataxia, tremor, and dysmetria. polyneuropathy, cranial nerve deficits, entrapment neuropathy (e.g. carpal tunnel syndrome), myopathic weakness, dementia, apathy, mental dullness, irritability, sleepiness, hoarseness, hypothermia and may be complicated by coma.

CARE PERTINENT TO EXTRACTION

The main danger is of precipitating myxoedema coma by the use of sedatives (including diazepam or midazolam), opioid analgesics (including codeine), or tranquilizer. These should, therefore, be either avoided or given in low dose. Local anesthesia is satisfactory for pain control. Conscious sedation can be carried out with nitrous oxide and oxygen. Diazepam or midazolam may precipitate coma. Associated problems may include hypoadrenocorticism, anemia, hypotension, diminished cardiac output and bradycardia. Occasional associations include hypopituitarism and other autoimmune disorders such as Sjogren's syndrome. Povidone-iodine and similar compounds are best avoided.

PATIENT ON EXOGENOUS STEROIDS

Corticosteroids are frequently used to suppress inflammation, and for immunosuppression, and occasionally to replace missing hormones like in Addison's disease or after adrenalectomy. Corticosteroids act by binding to cytoplasmic receptors, to produce alterations in regulatory protein synthesis. One regulatory protein, lipocortin (macrocortin). a member of the annexin superfamily of proteins, inhibits phospholipase A2 and so prevents metabolism of arachidonic acid to leukotrienes. prostaglandins and thromboxanes involved in inflammation. Glucocorticoids also increase beta-receptor synthesis, reduce microvascular permeability, reduce cytokine production and mast cells and eosinophils. Anti-inflammatory mechanisms involve the glucocorticoid receptors, the glucocorticoid-responsive genes, and the release of anti-inflammatory molecules such as lipocortin-1, IL-10. IL-1 ra. and nuclear factor-KB. Corticosteroids induce the transcription of the gene

to decrease the pro-inflammatory cytokine secretion. As a consequence, the immune system is 'blocked'. Corticosteroids have a negative feedback control on hypothalamic activity and ACTH production and there is, thus, suppression of the hypothalamic-pituitary-adrenocortical axis (HPA) and the adrenals may become unable to produce a steroid response to stress. Corticosteroids are an essential part of the body's response to stresses such as trauma, infection, general anesthesia or operation. At such times there is normally an enhanced adrenal corticosteroid response related to the degree of stress. In patients given exogenous steroids, the enhanced adrenal corticosteroid response may not follow. When the adrenal cortex is unable to produce the necessary steroid response to stress, acute adrenal insufficiency (adrenal crisis) can result, with rapidly developing hypotension, collapse and possibly death. Suppression of the HPA axis becomes deeper if corticosteroid treatment has been prolonged and/or the dose of steroids exceeds physiological levels (more than about 7.5 mg/day of prednisolone). Adrenal suppression is less when the exogenous steroid is given on alternate days or as a single morning dose (rather than as divided doses through the day). Corticotrophin (ACTH) has been used in the hope of reducing adrenal suppression, but the response is variable and unpredictable. However, adrenal function may even be suppressed for up to 1 week after cessation of steroid treatment lasting only 5 days. If steroid treatment is for longer periods, adrenal function may be suppressed for at least 30 days and perhaps for 2-24 months after the cessation of treatment. Patients on, or who have been on, corticosteroid therapy within the past 30 days may be at risk from adrenal crisis, and those who have been on them during the previous 24 months may also be at risk, if they are not given supplementary corticosteroids before and during periods of stress such as operation, general anesthesia, infection or trauma. Patients who have used systemic corticosteroids should be warned of the danger and should carry a steroid card indicating the dosage and the responsible physician. However, the frequency and

extent of the adrenocortical suppression (and the need for supplementary corticosteroids before and during periods of stress is unclear and has been questioned. Although the evidence for the need for steroid cover may be questionable, medicolegal and other considerations suggest that one should act on the side of caution and fully inform and discuss with the patient take medical advice in any case of doubt give a steroid cover unless confident that collapse is unlikely.

CARE PERTINENT TO EXTRACTION

Dentoalveolar or maxillofacial surgery may result in stress and a Cortisol response. Minor operations under local anesthesia may be covered by giving the usual oral steroid, dose in morning and giving oral steroids 2-4 h pre- and postoperatively (25-50 mg hydrocortisone or 20 mg prednisolone or 4 mg dexamethasone) or by giving IV 25-50 mg hydrocortisone immediately before operation. Intravenous hydrocortisone must be immediately available for use if the blood pressure falls or the patient collapses. Corticosteroids given by intramuscular injection are more slowly absorbed and reach lower plasma levels than when given intravenously or orally. Patients may also require special management as a result of diabetes, hypertension, poor wound healing, or infections. Aspirin and other nonsteroidal anti-inflammatory agents should be avoided as they may increase the risk of peptic ulceration. Susceptibility to infection is increased by systemic steroid use. In addition to careful aseptic surgery, prophylactic antimicrobials may be indicated.

PATIENTS RECEIVING WARFARIN THERAPY

Warfarin is an anticoagulant which inhibits synthesis of the vitamin K-dependent coagulation factors II, VII, IX and X. Indications for anticoagulation are increasing, and dentists will be consulted by patients taking warfarin. The activity of warfarin is expressed using the international normalized ratio (INR). $INR = (\text{patient PT} / \text{mean normal PT})^{ISI}$ or $\log INR = ISI (\log \text{observed PT ratio})$, where ISI denotes the International Sensitivity Index of the

thromboplastin used at the local laboratory to perform the PT measurement. The ISI reflects the responsiveness of a given thromboplastin to reduction of the vitamin K-dependent coagulation factors. The more responsive the reagent, the lower the ISI value. A normal coagulation profile has an INR of 1.0. The desirable INR range for patients depends on the condition being treated. Patients receiving treatment for deep vein thrombosis have a lower target range than those with prosthetic heart valves. The risk of bleeding increases exponentially as the INR rises. Gingival bleeding can indicate a raised INR. Oral surgery can be completed safely with an INR from 1.5 to 2.5. With appropriate local measures to reduce bleeding, teeth may be removed by simple extraction with an INR of 2-4. However dentists should still be cautious before they remove teeth where the INR exceeds 3 (Table 10.2). The possibility of postoperative bleeding in patients taking warfarin concerns dentists. However, before deciding if warfarin therapy should be interrupted the risk of perioperative or postoperative bleeding must be balanced against the risk of thromboembolism.

CARE PERTINENT TO EXTRACTION

Before extraction a thorough medical history should be obtained including details of any condition likely to be treated with warfarin. The dentist should also consider possible drug interactions with warfarin. Medications including antibiotics such as metronidazole, herbal remedies and alcohol may unpredictably alter the INR. If an interaction is considered likely or if the effect of any prescribed medication is not known, the dentist

should consult the doctor supervising the patient's anticoagulant therapy. The INR should be checked before surgery.

In most cases of dento-alveolar oral surgery, including simple extraction of teeth, bleeding can be controlled in a reasonable time by minimizing the extent of surgery to one site or quadrant, and using firm sutures or firm postoperative packs over the wound. Preferably surgery should be performed in the morning to facilitate postoperative observation.

Where the operative site is infected the use of antibiotics should be restricted to a preoperative prophylactic dose and postoperative antibiotics should be discontinued as soon as reasonable. Prolonged use of broad spectrum antibiotics should be avoided as it may change the effectiveness of warfarin by altering gut microflora compromising availability of vitamin K. Aspirin and non-steroidal anti-inflammatory drugs may also increase the risk of bleeding.

Local anesthetics should be given cautiously avoiding venepuncture. To avoid the needles becoming barbed and tearing tissues, they should be used once only for each mucosal or skin puncture. Local vasoconstriction may be encouraged by infiltrating a small amount of local anesthetic solution with 1:100 000 or 1:200 000 adrenaline close to the surgery site

PATIENTS TAKING ASPIRIN

Aspirin irreversibly impairs platelet aggregation and is used long-term in the prevention of cardiovascular events and stroke in patients at risk. In large doses, aspirin may also cause hypoprothrombinemia. Even small doses of

Table 10.2: Range of International Normalised Ratio

Type of treatment	Suboptimal range	Suboptimal range	Normal target INR range	Normal target INR range	May be normal target with mechanical heart valve	Out of range
	<1.5	1.6-1.9	2.0-2.5	2.5-3.0	3.1-3.5	3.5
Simple extraction	Safe	Safe	Safe	Local measures	Local measures	Not advised
Multiple extraction	Safe	Safe	Local measures	Local measures	Local measures	Not advised
Single bony impaction						

aspirin prolong the bleeding time, impair platelet adhesiveness. Aspirin may worsen bleeding tendencies if there are other anticoagulation medications other bleeding disorders, such as uremia. Patient taking even one 80 mg aspirin have platelet functions altered for upto a week until new, unaffected platelets are produced.

CARE PERTINENT TO EXTRACTION

In patients with no other cause for a bleeding tendency and receiving up to 100 mg aspirin daily, in general, for uncomplicated forceps extraction of 1-3 teeth. Suturing and packing the socket with resorbable gelatin sponge, oxidized cellulose, or microfibrillar collagen can be carried out if necessary. In patients with no other cause for a bleeding tendency and receiving doses of aspirin higher than 100 mg daily, if there is concern, the current value of the bleeding time should be established. If it is over 20 min. surgery should be postponed.

PATIENTS ON HEPARIN

Heparin is a natural product, abundant in granules of the mast cells that line the vasculature. It is released in response to injury. Heparin is also used as a parenteral anticoagulant, given subcutaneously or intravenously for acute thromboembolic episodes or for hospitalization protocols that include significant surgical procedures, to prevent deep venous thrombosis and pulmonary emboli. Heparin is a sulphated glycosaminoglycan originally obtained from liver. Heparin acts immediately on blood coagulation to block the conversion of fibrinogen to fibrin, mainly by inhibiting the thrombin-fibrinogen reaction via its binding to and catalysing antithrombin III. which then inhibits the serine proteases of the coagulation cascade to inactivate thrombin. Heparin also acts on activated factors IX-XII and increases platelet aggregation but inhibits thrombin-induced activation. The anticoagulant effect of standard or low molecular weight heparin has an immediate action on blood clotting, which is usually lost within 6 h of stopping it. The prothrombin, activated partial thromboplastin (APTT) and thrombin times (TT)

are prolonged. Most patients are monitored with the APTT and are maintained at 1.5-2.5 times the control value (the therapeutic range). Large doses of heparin can prolong the INR. Platelet counts should also be monitored if heparin is used for more than 5 days, since it can cause thrombocytopenia. Autoimmune thrombocytopenia is possible within 3-15 days, or sooner if there has been previous heparin exposure. Heparin is available as standard or unfractionated heparin, or low-molecular-weight (LMW) heparins. The latter, such as certoparin, interact with factor Xa. but do not affect standard blood test results.

CARE PERTINENT TO EXTRACTION

For uncomplicated forceps extraction of 1-3 teeth, there is usually no need to interfere with anticoagulant treatment involving heparin or low-molecular-weight heparins or antiplatelet drugs. Heparin has an immediate effect on blood clotting but acts for only 4-6 h and no specific treatment is therefore needed to reverse its effect. The effect of heparin is best assessed by the APTT. Withdrawal of heparin is adequate to reverse anticoagulation where this is necessary. In an emergency, this can be reversed by intravenous protamine sulphate given in a dose of 1 mg per 100IU heparin, but a medical opinion should be sought first. Where heparin has been stopped, any surgery can safely be carried out after 6-8 h. Low-molecular-weight heparin may have little effect either on the APTT or on postoperative bleeding, despite their longer activity (Up to 24 h). However, the advice of the hematologist should be sought before surgery.

HEMOPHILIA

Common forms of hereditary bleeding disorders caused by clotting factor deficiencies of factor VIII, IX, or XI. Hemophilia A (factor VIII deficiency), which affects about 80% of hemophiliacs, and hemophilia B (factor IX deficiency) have identical clinical manifestations, screening test abnormalities, and X-linked genetic transmission. Specific factor assays are required to distinguish the two. Hemophilia may result from gene

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mutations: point mutations involving a single nucleotide, deletions of all or parts of the gene, and mutations affecting gene regulation. About 50% of cases of severe hemophilia A result from a major inversion of a section of the tip of the long arm of the X chromosome. Because factor VIII and factor IX genes are located on the X chromosome, hemophilia affects males almost exclusively. Daughters of hemophiliacs will be obligatory carriers, but sons will be normal. Each son of a carrier has a 50% chance of being a hemophiliac, and each daughter has a 50% chance of being a carrier. Rarely, random inactivation of one of the two X chromosomes in early embryonic life will result in a carrier's having a low factor VIII or IX level to experience abnormal bleeding. A patient with a factor VIII or IX level < 1% of normal has severe bleeding episodes throughout life. Minor trauma can result in extensive tissue hemorrhages and hemarthroses, which, if improperly managed, can result in crippling musculoskeletal deformities. Bleeding into the base of the tongue, causing airway compression, may be life threatening and requires prompt, vigorous replacement therapy. Patients with factor VIII or IX levels about 5% of normal have mild hemophilia. They rarely have spontaneous hemorrhages; however, they will bleed severely (even fatally) after surgery if not managed correctly. Occasional patients have even milder hemophilia with a factor VIII or IX level in the 10 to 30% of normal range. Such patients may also bleed excessively after surgery or dental extraction.

Typical findings in hemophilia are a prolonged PTT, a normal PT and a normal bleeding time. Factor VIII and IX assays determine the type and severity of the hemophilia. Because factor VIII levels may also be reduced in VWD, VWF antigen should be measured in patients with newly diagnosed hemophilia A, particularly if the disease is mild and a family history cannot be obtained. After transfusion therapy, about 15% of patients with hemophilia A develop factor VIII antibodies that inhibit the coagulant activity of further factor VIII given to the patient. Patients should be screened for factor VIII anticoagulant activity (e.g. by measuring the

degree of PTT shortening immediately after mixing the patient's plasma with equal parts of normal plasma and after incubation for 1 h at room temperature), especially before an elective procedure that requires replacement therapy.

CARE PERTINENT TO EXTRACTION

Hemophiliacs should avoid using aspirin. There should be judicious use of other NSAIDs, which have a lesser, more transient effect than aspirin on platelet function. All drugs should be given orally or IV: IM injections can cause large hematomas. Fresh frozen plasma contains factors VIII and IX. However, unless plasma exchange is performed, sufficient whole plasma cannot be given to patients with severe hemophilia to raise factor VIII or IX concentrations to levels that effectively prevent or control bleeding. For hemophilia A, the treatment of choice is viral inactivated or recombinant factor VIII concentrate. For hemophilia B, the treatment of choice is a highly purified viral inactivated factor IX concentrate.

In hemophilia A, the factor VIII level should be raised transiently to about 0.3 U (30%) to prevent bleeding after dental extraction.

In hemophilia B, the plasma factor IX level rises to only half of that expected from the units of factor IX listed on the bottle. This may reflect binding of infused factor IX to vascular endothelium.

An antifibrinolytic (-aminocaproic acid 2.5 to 4 g postoperative qid for 1 week or tranexamic acid 1.0 to 1.5 g postoperative tid or qid for 1 week) should be given to prevent late bleeding after dental extraction. Treatment of bleeding in hemophiliacs who develop a factor VIII inhibitor is difficult, and a specialist should be consulted. Patients with a low initial antibody titer may be given a large dose of factor VIII to overcome the inhibitor and temporarily raise plasma factor VIII concentration. If this does not control the bleeding, further factor VIII infusion will usually be futile because of the rapid rise in antibody titer. The factor VIII antibodies responsible for inhibitor activity are heterogeneous and in some patients do not inhibit or only minimally inhibit

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porcine factor VIII. Thus, a high-purity porcine factor VIII preparation controls bleeding in such patients. Prothrombin complex concentrate, which contains factor IX and variable amounts of an activity that bypasses the role of factor VIII in coagulation, has also been used to manage serious bleeding in patients with a high-titer inhibitor, but it may also induce hypercoagulability and a paradoxical thrombotic event. The factor VIII inhibitor-bypassing material in prothrombin complex concentrate may be factor IXa. Recombinant factor VIII in repeated high doses (e.g. 90 ug/kg) controls bleeding in some patients with a factor VIII inhibitor without inducing a hypercoagulable state. Long-term control of inhibitors in hemophilia A is achieved in most patients by inducing immune tolerance through continuous exposure to factor VIII.

PREGNANCY

Pregnancy is a major event in any woman's life and is associated with physiological changes affecting especially the endocrine, cardiovascular and hematological systems and often attitude, mood, behavior. Knowledge of physiologic changes from non-gravid woman to gravid woman is of utmost importance to dental surgeon. The hormonal and physiologic changes during gestation results in alteration of major organ system.

The dental surgeon who treats a gravid woman should be aware that he/she is treating two patients, the unborn child the second one. In most instances surgery can be performed safely with proper consultation. Most experts agree that elective surgical procedures should be delayed until after delivery. Physiologic changes are due to hormonal release, anatomic changes or both.

The normal period of pregnancy is approximately 38 weeks - 9 months. For clinical purposes, the gestation period is usually divided into trimesters (period of 3 months), because each trimester presents different considerations in medical and dental management. Trimester approach is safe for mother and child because it accounts the period of greater risk of harming the

developing fetus or embryo. The embryonic period spanning weeks 2 through 8 post conception, is the time of active organogenesis and therefore greater susceptibility to teratogens. The concern of doing procedure during the first trimester is two-fold. First, the developing child is at greatest risk posed by teratogens during organogenesis, and second during the first trimester it is known that as many as one in five pregnancies undergo spontaneous abortion. The current recommendation is that necessary procedures be done during second trimester. By the second trimester, organogenesis is completed, and the risk to the fetus is low. The mother has also had time to adjust to her pregnancy, and the fetus has not grown to a potentially uncomfortable size that would make it difficult for the mother to remain still for long periods. The positioning of the pregnant patient is important, especially during the third trimester. As the uterus expands with the growing fetus and placenta, it comes to lie directly the inferior vena cava, femoral vessel, and the aorta. If the mother is positioned supine for a procedure the weight of the gravid uterus could apply enough pressure to impede blood flow through the major vessels and cause a condition called supine hypotension. In this condition, the blood pressure drops secondary to the impeded blood flow, which causes a syncopal or near syncopal episode. This situation is easily remedied by proper positioning of the patient on her left side and elevating the head of the chair to avoid compression of major vessels.

CARE PERTINENT TO EXTRACTION

Detailed information of pregnancy state is obtained and non urgent treatment should be delayed to the postpartum period. If patient is unsure regarding her pregnancy refer to physician. In case of emergency situation inquire about last menstrual period cycle. The fetus is most susceptible to harmful effect of teratogens, carcinogens and maternal stress during first and third trimester. Certain procedures when clinically indicated may be deferred to 2nd trimester. Important points to be stressed before doing any extraction procedure is the stress of

surgery, stress of anesthesia, ionizing radiations, drugs. It is generally accepted that dental radiographs and minor procedures like exodontia under local anesthesia expose fetus to minimal risk. Gynecological consultation should be taken before performing exodontia. Risk benefit ratio of delaying treatment is made on time of presentation and progress of disease. Beyond first trimester, gravid patient should not be placed in supine position because enlarged gravid uterus compresses the vena cava and decreases cardiac output as low as 30% results in supine hypotension syndrome of pregnancy. Compression of vena cava increases venous stasis and enhances risk of clot formation. Signs and symptoms include light-headedness, tachycardia, loss of consciousness. The appropriate and desired position is left lateral position with right buttock and hip elevated to approximately 15 degrees. Local anesthesia should be preferred over general anesthesia.

Procedures like extraction of teeth have the potential to escalate into bacteremia and sepsis, with resulting serious fetal complications making antibacterial treatment and prophylaxis important in pregnant patients. Obstetrician's consult if doubtful about the teratogenic effects of a medication.

Drugs which can be safely administered include Acetaminophen or its combination with oxycodone (opioid analgesic) for mild to severe pain control. Beta-lactam antibiotics like Penicillin. Amoxicillin. Cephalosporin.

Drugs contraindicated are estolate form of erythromycin base because it increases risk of cholestatic hepatitis.

Tetracyclines have increased effect on developing teeth and bones. Chloramphenicol. Metronidazole have carcinogenic effects. Narcotics cause respiratory depression in fetus and mother.

NSAIDs in 3rd trimester prolong pregnancy and labor. It causes anti- and post-partum hemorrhage, increased chances of oral clefts and other defects, increased chances of fetal mortality.

EPILEPSY

It is a brain disorder which manifests as chronic, sudden, often recurrent, paroxysmal, discharge of the cerebral neurons, resulting in episodic disturbances of consciousness and autonomic nervous system. Convulsive or involuntary muscle movements called as seizures /fits. It affects about 1-2% of general population, but more prevalent in young and handicapped patients. Epilepsy is characterized by seizures of any type that are chronic and recurrent. In addition to seizures, there may be other features, such as headache, changes in mood or energy level, confusion, and memory loss. The main types of epilepsy are generalized seizures (grand mal (tonic-clonic) and petit mal) - when consciousness is typically lost and petit mal. Partial seizures, which include simple seizures during which the person remains alert, but there are abnormal movements or sensations. In complex seizures abnormal movement or sensation is accompanied by changes in consciousness. Generalized seizures are the most dramatic but partial complex seizures are the most common.

CARE PERTINENT TO EXTRACTION

Epileptics can have good and bad phases, and exodontia should be carried out in a good phase, when attacks are infrequent. Various factors can precipitate attacks. Those who have infrequent seizures, or who depend on others (such as those with a learning impairment), may fail to take regular medication and thus be poorly controlled. Drugs can be epileptogenic or interfere with anticonvulsants, or can themselves be changed by anticonvulsant therapy and may, therefore, be contraindicated. One should have comprehensive knowledge of patient's seizure history and medications. Avoidance of situations likely to provoke a seizure and PAS complex by strictly implementing stress reduction protocol. In acute attack-situation following steps should be taken, terminate dental therapy and position the patient supine on the floor, if unconscious.

Protect the patient from injury by passive restraint in the event of a seizure. Remove him/her from any

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proximity to sharp edges, a fall or other trauma. Loosen any tight collar or other clothing.

Lightly restrain, if needed. To prevent any injury to lips, tongue and to establish a patent airway, following steps are taken immediately - Turn the patient on his/her side in the dental chair with the head extended. A well padded tongue blade available is kept in between teeth. Supplemental O₂ may be necessary in worse conditions. Local anesthetics readily cross the blood-brain barrier. At low (therapeutic/non-toxic) levels, no CNS effects are clinically significant. At higher/toxic/overdose) levels, a generalized tonic-clonic episode is seen. Patients on valproic acid may have a prolonged bleeding time, thus bleeding time should be determined prior to surgery.

ASTHMA

Asthma is a chronic inflammatory disease characterized by reversible airway obstruction. This disorder is typified by bronchial edema caused by hypersensitivity to either known or unknown stimuli and which results in airway-narrowing. This process is also associated with increased mucin secretion and diminished ciliary action, further compounding obstruction.

Asthma is broadly classified by the principle stimuli that incite an acute episode rather than specific etiologic parameters. Some classification systems divide asthma into 2 basic groups: allergic, or extrinsic asthma versus idiosyncratic or intrinsic asthma.

Other proposed classification systems for chronic asthma are based on disease severity according to the frequency of acute attacks. This classification system divides asthma into mild intermittent, mild persistent, moderate persistent and severe persistent categories. Furthermore, such classification based on severity lends itself nicely to specific treatment approaches for each category,

Regardless of the various classification systems. The etiology of asthma is both poorly understood and poorly defined. Asthma is an inflammatory process associated

with bronchial hyper-responsiveness, bronchial lumen decreases in diameter because of edema, mucus production, and hypertrophy of the bronchial wall.

Typical symptoms of asthma include wheezing, chest tightness, cough, and dyspnea. The frequency and the severity of asthma symptoms vary among patients and within individual patient episodes. Physical evaluation of the patient may reveal expiratory wheezing with or without expiratory phase prolongation or tachypnea. In acute asthma flares, use of the accessory muscles of respiration is also characteristic. Pulmonary function tests, primarily spirometry, are necessary to establish or confirm a diagnosis of asthma and assess its severity.

CARE PERTINENT TO EXTRACTION

Optimal asthma control is desirable before dental treatment. The dentist must also remember that some medications used in dentistry may have specific implications in the treatment of a patient with asthma. Aspirin, as well as other nonsteroidal anti-inflammatory medications, should be avoided in aspirin-sensitive persons with asthma because they could trigger an acute asthma attack. In general, nonsteroidal anti-inflammatory medications, including aspirin, should be used with caution in all persons with asthma because these medications inhibit cyclo-oxygenase and preferentially generate leukotrienes. Opiates, which cause respiratory depression and which can induce histamine release, should also be avoided. Macrolide antibiotics (e.g. erythromycin), which alter cytochrome P450, may result in elevated serum methyl xanthine (theophylline) levels. In addition, sulfite preservatives, as those found in some local anesthetics (i.e., those with vasoconstrictors, such as levonordefrin and epinephrine), can precipitate asthma attacks. Other concerns for the dentist include the requirement of steroid supplementation-before stressful or perceived stressful dental procedures-in patients with severe asthma who are on a long-term regimen of systemic corticosteroids. Proper preparation of the asthmatic patient before dental therapy may enhance

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the dentist's ability to emergently manage an acute asthmatic attack. Patients should be advised to bring their short-acting beta agonist inhaler medications to the dental appointment.

PATIENTS RECEIVING RADIOTHERAPY

Radiotherapy is often used to treat oral cancer. It can be used alone or as adjuvant to surgical procedure aiming to treat oral cancer. Many oral complications can follow radiotherapy involving oral cavity and salivary glands. Radiotherapy to tumors of the mouth, naso and oropharynx is especially liable to damage the salivary glands, depress salivary secretion and result in saliva of a higher viscosity but lower pH. Salivary secretion diminishes within a week of radiotherapy in virtually all patients and the saliva becomes thick and tenacious. Infections are predisposed to by xerostomia. Caries, oral candidosis and acute ascending sialadenitis are typical consequences. Some salivary function may return after many months.

CARE PERTINENT TO EXTRACTION

Before radiotherapy meticulous oral hygiene should be implemented. Neglected and unsalvageable teeth in the radiation path should be extracted. An interval of at least 2 weeks between extracting the teeth and starting radiotherapy is desirable but the time interval permitted between extractions and radiotherapy is invariably a compromise because of the need to start radiotherapy as soon as possible. No bone should be left exposed in the mouth when radiotherapy begins since, once the blood supply is damaged by radiotherapy, wound healing is jeopardized.

After radiotherapy oral hygiene and preventive dental care should be continued. If extractions become unavoidable, trauma should be kept to a minimum, raising the periosteum as little as possible, ensuring that sharp bone edges are removed, suturing carefully and giving prophylactic antibiotics in adequate doses from 48 h preoperatively and continued for 4 weeks at least. Clindamycin 600 mg tds is an appropriate antibiotic since it penetrates bone well.

Chapter

Extraction Under
General
Anesthesia

11

Exodontia Practice

General anesthesia (GA) has been one of the far-reaching inventions of medical science. The use of general anesthesia in dentistry began in 1844 when Connecticut dentist Horace Wells first used the chemical compound nitrous oxide, commonly known as laughing gas. to relieve pain during a dental procedure. Two years later, his former partner. William Thomas Morton, introduced the use of ether as a general anesthetic at a public demonstration.

Though general anesthesia is an expensive component of a surgical procedure, recent economic development in India has widened the scope for extraction of teeth under general anesthesia. Various anesthetic agents are available and readers are advised to refer to appropriate general anesthesia textbook.

It is imperative to understand that though dental extraction is classified as a minor surgical procedure, the morbidity and mortality from general anesthesia still remains same to a large extent. Any complication from the procedure is there for not well tolerated by patient. Fortunately most complications are minor but occasionally respiratory and cardiac arrests will occur. Proper case selection and precautions can only reduce these complications but cannot eliminate it from happening.

INDICATIONS FOR GENERAL ANESTHESIA

- 1. Anxious patient.
- 2. Difficult procedure (e.g. very low lying third molar).
- 3. Pediatric dental extraction in a non-cooperative child.
- 4. Extraction in people with special needs, e.g. cerebral palsy, learning difficulties.

CONTRAINDICATIONS FOR GENERAL ANESTHESIA

Cardiovascular and respiratory diseases are the most common limiting factors for GA. A detailed questionnaire is provided to go through when a patient is planned for GA. Any significant medical problem needs to be investigated and discussed with the anesthetist. Amount

of exercise tolerance gives a good indication of fitness for general anesthesia. Finally it is the individual anesthetist's skill and acute care facilities, which determines the patient selection.

One of the common reasons for cancellation in day case procedure is due to non-fasted patients. Patient needs to be nil by mouth for eight hours. All regular medication needs to be checked by the anesthetist to advise on taking them on the day of the operation. Use of chewing gums or drinking tea/coffee with milk will stimulate gastric secretion which can regurgitate leading to aspiration pneumonia which can be fatal.

Dental extractions under GA are routinely carried out in developed countries. The assessment of these patients is mainly carried out using American Society of Anesthesiologists (ASA) grading. Medical co-morbidity increases the risk associated with anesthesia and surgery. ASA accurately predicts morbidity and mortality (Table 11.1). In general fifty percent of patients presenting for elective surgery are ASA grade 1. This number is very likely to be large in maxillofacial surgery as the age group of people who have wisdom teeth removed are in a younger age group and are generally fit and healthy. Operative mortality for these patients is less than 1 in 10,000.

Table 11.1: ASA predicts mortality and morbidity

ASA Grade	Definition	Mortality (%)
I	Normal healthy individual	0.05
II	Mild systemic disease that does not limit activity	0.4
III	Severe systemic disease that limits activity but is not incapacitating	4.5
IV	Incapacitating systemic disease which is constantly life-threatening	25
V	Moribund, not expected to survive 24 hours with or without surgery	50

Any contraindication for extraction under local anesthesia (apart from those which indicates GA) will also apply to GA for. e.g. bleeding disorders unless corrected.

CONSENT

Obtaining an informed consent is an important and recommended practice of modern day surgery. Though it is not something routinely carried out in Indian circumstances due to difference in practice of surgery. With the increasing health awareness and publicity of medicolegal issues, informed consent should be incorporated in routine practice by explaining the importance of it to patients.

The extent of warning should involve routine complications like numbness of tongue and lip following third molar removal. It is advisable to cover the risks of GA either separately by the anesthetist or as a team.

It is always advisable to discuss the possible outcomes and change of plans intraoperatively. for example, it is advisable to include the adjacent tooth on the extraction list if it is radiographically carious and found to be beyond restoration clinically once adjacent tooth is extracted. It is not a good idea to wake the patient to inform the changes.

GENERAL ANESTHESIA AND CONSIDERATIONS FOR INTRAORAL PROCEDURE

All intraoral procedures have limited access and presence of endotracheal tube can only make it more difficult. The two clinical exercise which should be part of a clinical assessment for GA are mouth opening and neck extension. Poor mouth opening is not only a surgical difficulty but also anesthetic. When there is trismus secondary to infection and suspected airway compromise as well, the team should be ready to carry out emergency tracheostomy if needed. The use of fiberoptic guided intubation technique is more safe and can avoid emergency tracheostomy. Patients with reduced neck extension should be discussed with anesthetist before hand.

Technically, blind nasal intubation is more difficult than placing oro-endotracheal tube. Where good access is needed, surgeon needs to inform the anesthetist the requirement of nasoendotracheal intubation. Where

simple extractions are planned, oral intubation using Portex[®] cuffed oral endotracheal tube-PDT which are soft and specially engineered for maxillofacial surgery can be used. They provide enough maneuvering for retraction using tongue retractors. It is always a good idea to inform the anesthetist when their position is changed for access.

Laryngeal mask airways are alternative airway devices which are successfully used in short general anesthesia. They can be used when there is adequate access is available and the procedure is short and patient does not have any contraindication for laryngeal mask airway like morbidly obese patients or procedures close to oropharynx.

POSITIONING FOR GENERAL ANESTHESIA

The patient needs to be kept comfortable and any soft tissue damage by pressure needs to be avoided. These injuries will be severe as most often they go unnoticed till patient is awake. Soft cushioning jelly pads are routinely used. This has a major significance especially when the routine short procedure is prolonged due to any complication. Catheterization is not routinely required.

The layout for anesthetist and his equipment, operating lights, scrub nurse, operator and assistant needs to be planned before hand as moving anesthetic machine or operating table is cumbersome and will delay the procedure. It is important to move the operating light whenever patient or operator's position is changed.

POSITIONING OF THE OPERATOR

The positioning of the operator varies individually but in general it is better to stand on the side of the operation to enhance access and visibility. Most of the extraction forceps are designed for patients sitting in a dental chair: therefore operators need to use non-conventional use of forceps for patients in supine position during general anesthesia. For example, the author finds lower anteriors are some times better accessed from 12 O' clock position with an upper anterior forceps.

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IDENTIFYING THE RIGHT TOOTH

Marking the site of surgery is an integral part of preparing the patient for theater. Though it is not widely used, marking the tooth is suggested by some. It is imperative for the actual surgeon to do an oral examination just before the surgery. The assistant has to be equally vigilant to avoid any wrong tooth extraction. Charting the whole mouth before extraction is a very useful safety technique, especially when multiple extractions are planned. Marking the tooth to be extracted on the OPG (which should have patients name and date of exposure and sides correctly oriented) and writing it on the board is a safe practice and reduces the intraoperative confusion, delays and medicolegal issues. Before applying the forceps or elevator, the surgeon must re-check the notes. The importance of preoperative examination cannot be emphasized enough as symptoms cannot be elicited once the patient is anesthetized. This also gives an opportunity to check if the symptoms have resolved or changed warranting change of treatment plan.

In certain situations where complete clinical examination is not possible, examination needs to be carried out along with whole mouth charting. There should be low threshold for extracting teeth in these patients as restoration on a later date may not be possible and further GA may be needed to complete the extractions. It is important to plan restoration at the same time where possible to avoid unnecessary distress to patient.

SURGICAL CONSIDERATIONS FOR GENERAL ANESTHESIA

Surgical procedures under GA need to be planned to avoid any unnecessary delay or cancellation of procedures. All equipment needs to be checked and availability of instruments should be confirmed. Any special need or equipment should be informed prior hand to theatre staff. The most important thing is the skill of the surgeon. He should be skilled enough not only to carry out the procedure but also to handle any complications like fractured roots, root in the antrum or an oro-antral fistula.

Extraction under GA is usually complicated by the fact that area of airway maintenance by anesthetist and operating site are very close to each other and co-ordination between the two is crucial. Standard two towel draping is recommended. Many surgeons prefer not to prepare the skin or oral cavity prior to surgery but using a mouthwash on the ward preoperatively is recommended.

Local anesthesia (LA) is mainly used to obtain adequate postoperative pain control and long acting agents like bupivacaine is preferred. They usually contain adrenaline for its hemostatic property. Local anesthesia is also shown to avoid any tachycardia due to stimulation of nerve fibers but presence of adrenaline can cause immediate tachycardia and therefore should be told to anesthetist prior to injection. Care should be taken not to dislodge the anesthetic tube while operating especially where advanced anesthetic machines, which have sensitive alarms, are not available.

The airway must be protected from any copious irrigation, fractured tooth, filling and any other debris. Relying on the endotracheal cuff is not sufficient and the anesthetist routinely places a throat pack. At the end of the procedure all extracted teeth and fractured crowns and fillings, roots, instruments, swabs and needles must be accounted for. If it is not, immediate bronchoscopy should be arranged where facilities available or an urgent chest and abdominal X-ray should be arranged. It is the surgeon's duty at the end of the procedure to remove the throat pack and the team needs to record it. You forget to take it out only once.

Obtaining good access to carry out the procedure is very prudent. It is advisable to use a mouth prop on the non-operating side to keep the mouth open. The tongue needs to be retracted with out damaging the floor of the mouth mucosa. They should also retract the throat pack which should be placed beyond oropharynx to avoid entanglement to high speed burs leading to soft tissue injury. Cheek retractors need to be in place and should be held by hand rather than the surgeons gown to avoid any accidental injury to cheek.

Extraction Under General Anesthesia

It is recommended that surgeon informs the anesthetist about the proceedings of the surgery so that they can plan the anesthesia. This will avoid unnecessary prolongation of the anesthetic time due to muscle relaxants and other drugs given for longer periods than needed.

Placing immediate dentures and loose intraoral packs can be difficult especially if they are ill fitting. They are potential to obstruct the airway. It is advisable to place them in when patient is more alert in the recovery when local anesthetic is still working and tissues haven't swollen. Small pressure packs used to press on the extraction socket can come off and obstruct the airway. A long pack sufficiently hanging outside the mouth which is easily retrievable should be used and removed once bleeding has stopped.

Most of the time extraction under general anesthesia is carried out due to some special needs and stopping bleeding from their extraction sockets when they are awake can be very difficult and some times may need another anesthesia. It is ideal to put sutures and obtain good homeostasis to avoid an unpleasant complication of post extraction hemorrhage in a non co-operative patient. When in doubt, place surgicel in the socket and horizontal mattress suture to compress the socket.

POSTOPERATIVE INSTRUCTION

It is important to provide postoperative instructions prior to surgery so that patient can make necessary arrangement and also he will not be in a state to receive any instruction after a GA in the initial hours. The language of choice should be the one patient is comfortable with.

COMPLICATIONS OF EXTRACTION UNDER GENERAL ANESTHESIA

Complications of extraction in general are covered in a different chapter but specific complications arising mainly under GA are covered here.

Inadvertent force while carrying out extraction under GA is not uncommon and can result in various complications. Fractured mandibles are mainly associated following removal of third molars. Should this happen the surgeon should proceed directly to fixing the fracture and fully explain the situation to the patient post-operatively. It is easy to forget the traction on temporomandibular joint while applying the force. This is only felt after patient has recovered from anesthesia and can be very uncomfortable, some times more than the pain at the surgical site. Supporting the mandible, applying mouth prop and applying controlled, guided force reduces the risk of such damage. On completion of treatment, before taking the throat pack out the operator must ensure that mandible can come to centric occlusion to rule out TMJ dislocation unless patient is intubated orally.

Soft tissue injury is not uncommon under GA. Most commonly the angle of the mouth is injured due to injudicious retraction or friction from the instruments. Poor access and visibility contributes to the problem. Copious amounts of skin lubricants/ moisturizing cream should be applied to lips preoperatively and also postoperatively. Care should be taken as instruments can get very slippery due to lubricant coat.

It is important to make sure that autoclave instruments are cool before being used. Surgical gloves do not conduct heat well and can give false low temperature leading to tissue trauma. Eyes should be covered at all the time as they are exposed to sharp material and high velocity rotary instruments. Use of cautery for dental extraction is rare but if needed bipolar cautery is more advisable to prevent soft tissue injury.

POSTOPERATIVE INSTRUCTIONS

Patient information for removal of teeth under GA

1. You may not have anything to eat or drink (including water) for eight (8) hours prior to the appointment.
2. A responsible adult must accompany the patient to the office, remain in the office during the procedure, and drive the patient home.

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3. The patient should not drive a vehicle or operate any machinery for 24 hours following the anesthesia experience.
 4. Contact lenses, jewelry, and dentures must be removed.
 2. Stiffness of the muscles may cause difficulty in opening your mouth for a few days
 3. You may develop sore throat and ear ache which are temporary.
 4. The corners of the mouth may become dry and crack. Your lips should be kept moist with cream or ointment.
 5. There may be a slight elevation of temperature for 24 to 48 hours. If temperature continues, notify us. Further information may be added as per- post-operative instruction following extraction under L.A.
- POSTOPERATIVE INFORMATION
1. The surgical area will swell and will be more swollen on the 2nd or 3rd postoperative day.

Chapter

Healing of
Extraction Socket

12

The healing of wounds is one of the most interesting of the many phenomena which characterize the living organism. The ability of damaged tissue to repair itself is a response of life itself, and within this very process may lie the final understanding of nature. It is said that an unhealed wound will eventually result in the death of the organism. Therefore, wound healing must be considered one of the primary survival mechanisms from birth onward. It should be clearly understood that the healing of a wound is not an isolated, solitary phenomenon but actually a very complex series of biologic events. Classic reviews of this dynamic process are those of Arey in 1936 and of Schilling in 1968.

Repair of tissue is generally considered to be a phase of the inflammatory reaction, since it cannot be separated from the preceding vascular and cellular phenomena occurring in response to an injury. Healing of all tissues after injury has an essentially identical pattern, but this healing may be modified considerably, depending upon numerous intrinsic and extrinsic factors.

Oral wounds are common, some being sustained accidentally and others being inflicted by the dentist for a specific purpose. The unusual anatomic situation of the oral cavity, the teeth protruding from the bone, the constant inflammation present in the gingival tissues, the presence of countless microorganisms in a warm, moist medium of saliva contribute to modify the healing reaction of the various wounds. It is, these reparative phenomena and their alterations from the basic pattern which are discussed in this chapter.

HEALING OF THE EXTRACTION WOUND

A thorough understanding of the phenomenon of healing of extraction wounds is imperative to the dentist, since vast numbers of teeth are extracted because of pulp and periapical infection as well as various forms of periodontal disease, and there is an ever-present possibility of complications in the healing process.

A number of careful scientific studies have been carried out, both on the experimental animal and in the human being, dealing with undisturbed as well as complicated

extraction wound healing. The healing of an extraction wound does not differ from the healing of other wounds of the body, except as it is modified by the peculiar anatomic situation, which exists after the removal of a tooth. The healing process to be described here is a composite of the various studies reported in the literature and, while minor variations in the time sequence have been described, the uncomplicated healing of an extraction wound in the human may be expected to parallel that described later. Normal human biologic variation precludes the establishment of a day-to-day timetable for such healing wounds, the healing process can only be described as an "average" sequence of events.

IMMEDIATE REACTION FOLLOWING EXTRACTION

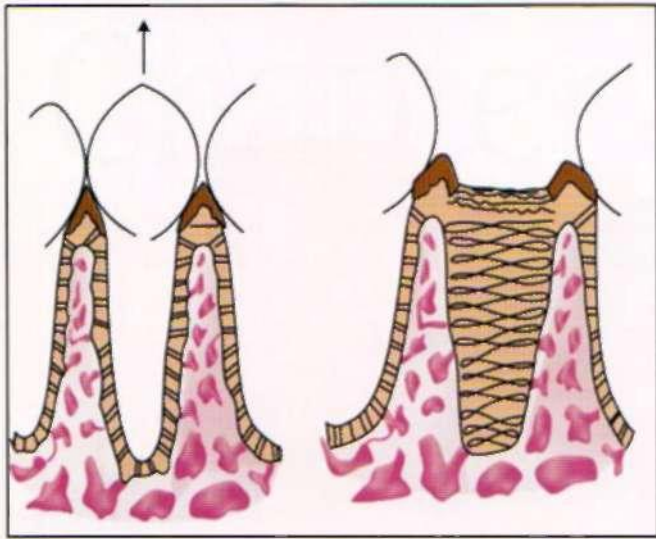
After the removal of a tooth, the blood which fills the socket coagulates, red blood cells being entrapped in the fibrin meshwork, and the ends of the torn blood vessels in the periodontal ligament become sealed off. The hours after tooth extraction are critical, for if the blood clot is dislodged, healing may be greatly delayed and may be extremely painful.

Within the first 24 to 48 hours after extraction, a variety of phenomena occur which consist principally of alterations in the vascular bed. There are vasodilatation and engorgement of the blood vessels in the remnants of the periodontal ligament and the mobilization of leukocytes to the immediate area around the clot. The surface of the blood clot is covered by a thick layer of fibrin, but at this early period visible evidence of reactivity on the part of the body in the form of a layering of leukocytes here is not particularly prominent. The clot itself shows areas of contraction. It is important to recognize that the collapse of the unsupported gingival tissue into the opening of a fresh extraction wound is of great aid in maintaining the clot in position (Figures 12.1A and B).

FIRST-WEEK WOUND

Within the first week after tooth extraction, proliferation of fibroblasts from connective tissue cells in the remnants of the periodontal ligament is evident, and fibroblasts

Healing of Extraction Socket



Figures 12.1A and B: Tooth socket immediately after extraction

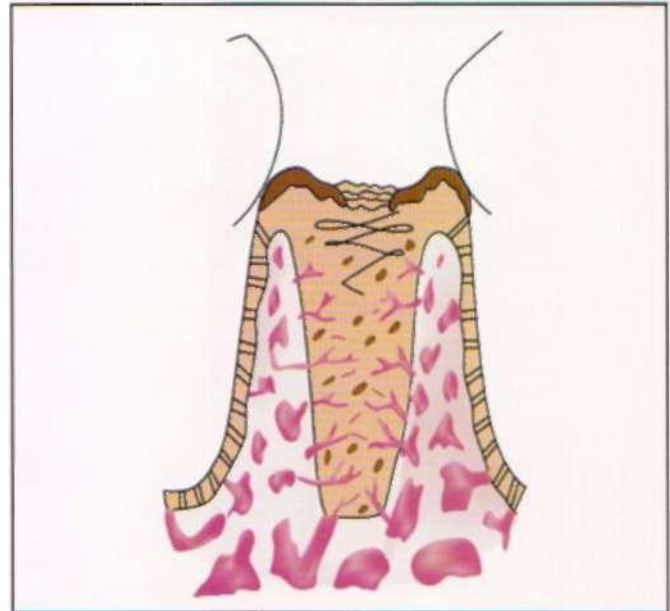


Figure 12.2: First week extraction wound

have begun to grow into the clot around the entire periphery. This clot forms an actual scaffold upon which cells associated with the healing process may migrate. It is only a temporary structure, however, and is gradually replaced by granulation tissue. The epithelium at the periphery of the wound exhibits evidence of proliferation in the form of mild mitotic activity even at this time. The crest of the alveolar bone which makes up the margin or neck of the socket exhibits beginning osteoclastic activity. Endothelial cell proliferation signaling the beginning of capillary in growth may be seen in the periodontal ligament area.

During this period, the blood clot begins to undergo organization by the in growth around the periphery of fibroblasts and occasional small capillaries from the residual periodontal ligament. Remnants of this periodontal ligament are still visible, but as yet there is no evidence of significant new osteoid formation, although in some cases it may have just commenced. An extremely thick layer of leukocytes has gathered over the surface of the clot, and the edge of the wound continues to exhibit epithelial proliferation (Figure 12.2).

SECOND-WEEK WOUND

During the second week after extraction of the tooth, the blood clot is becoming organized by fibroblasts

growing into the clot on the fibrinous meshwork. At this stage, new delicate capillaries have penetrated to the center of the clot. The remnants of the periodontal ligament have been gradually undergoing degeneration and are no longer recognizable as such. Instead, the wall of the bony socket now appears slightly frayed. In some instances, trabeculae of osteoid can be seen extending outward from the wall of the alveolus. Epithelial proliferation over the surface of the wound has been extensive, although the wound is usually not covered, particularly in the case of large posterior teeth. In smaller sockets, epithelialization may be completed. The margin of the alveolar socket exhibits prominent osteoclastic resorption. Fragments of necrotic bone which may have been fractured from the rim of the socket during the extraction are seen in the process of resorption or sequestration (Figure 12.3).

THIRD-WEEK WOUND

As the healing process continues into the third week, the original clot appears almost completely organized by maturing granulation tissue. Very young trabeculae of osteoid or uncalcified bone are forming around the entire periphery of the wound from the socket wall. This

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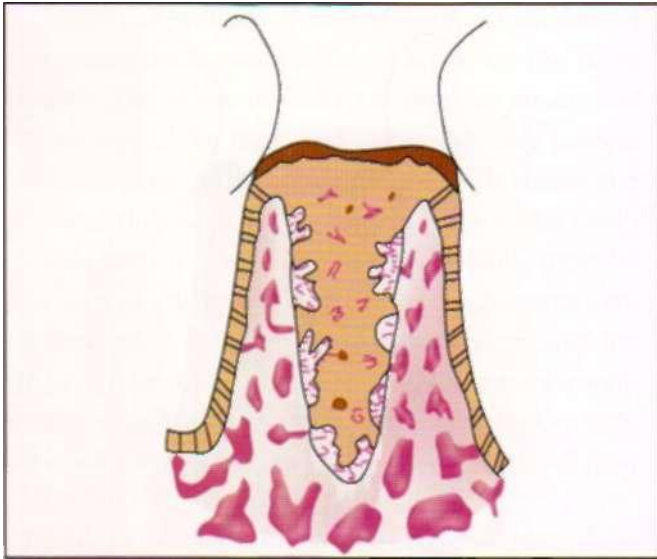


Figure 12.3: Third week extraction wound

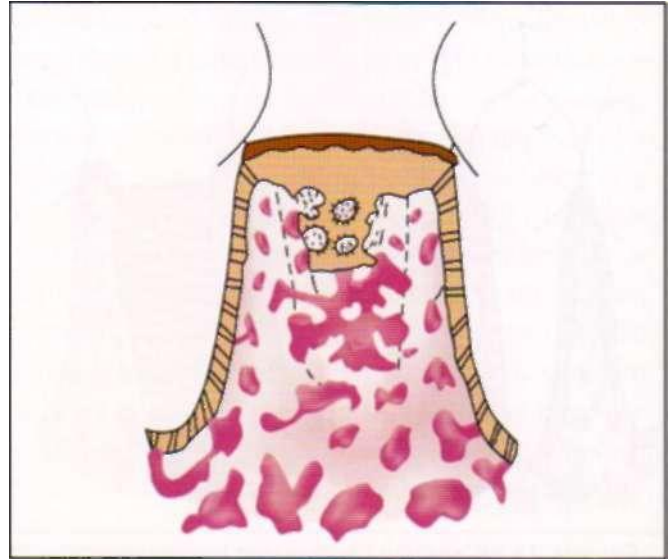


Figure 12.4: Fourth week extraction wound

early bone is formed by osteoblasts derived from pluripotential cells of the original periodontal ligament which assume an osteogenic function. The original cortical bone of the alveolar socket undergoes remodeling so that it no longer consists of such a dense layer. The crest of the alveolar bone has been rounded off by osteoclastic resorption. By this time the surface of the wound may have become completely epithelized (Figure 12.4).

FOURTH-WEEK WOUND

During the fourth week after the extraction, the wound begins the final stage of healing, in which there is continued deposition and remodeling resorption of the bone filling the alveolar socket. However, this maturative remodeling will continue for several more weeks. Much of this early bone is poorly calcified, as is evident from its general radiolucency on the roentgenogram. Roentgenographic evidence of bone formation does not become prominent until the sixth or eighth week after tooth extraction. There is still roentgenographic evidence of differences in the new bone of the alveolar socket and the adjacent bone for as long as four to six months after extraction in some cases. Because the crest of alveolar bone undergoes a considerable amount of

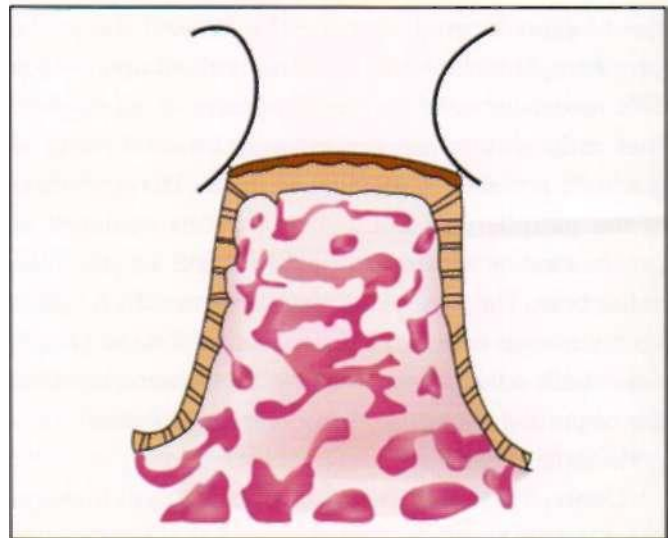


Figure 12.5: Healed extraction socket

osteoclastic resorption during the healing process and because the bone filling the socket does not extend above the alveolar crest, it is obvious that the crest of the healed socket is below that of the adjacent teeth. Surgical removal of teeth, during which the outer plate of bone is removed, nearly always results in loss of bone from the crest and buccal aspects, producing in turn a smaller alveolar ridge than that after simple forceps removal of teeth. This may be of considerable significance in the preparation of a prosthetic appliance (Figure 12.5).

Chapter

Complications of
Tooth Extraction

13

No surgical procedure is guaranteed to be free of complications and tooth extraction is no exception. Whilst the risk of certain adverse events can be minimized with forethought at the assessment stage and careful execution of the surgery, some of the problems that arise are totally unpredictable.

Any deviation from the normal procedure is called as complication. Complication at the time of exodontias can occur at the time of giving anesthesia (anesthetic complications), at the time of removal of tooth (intra-operative complication) or after removal of tooth (postoperative complications). In this chapter we will discuss intraoperative and postoperative complications.

LOCAL COMPLICATIONS

IMMEDIATE

- Failure of local anesthesia
- Failure to move the tooth
- Fracture of the tooth or root being extracted
- Fracture of the alveolus (including maxillary tuberosity)
- Oro-antral communication
- Displacement of the tooth or a root into the tissues. Loss of a tooth or part of a tooth into the pharynx and then to the lung
- Fracture or subluxation of an adjacent tooth
- Collateral damage to surrounding soft tissues
- Hemorrhage
- Dislocation of the temporomandibular joint
- Fracture of the mandible
- Damage to branches of the trigeminal nerve.

DELAYED

- Excessive pain
- Swelling
- Trismus
- Hemorrhage
- Localized osteitis (dry socket)
- Acute osteomyelitis
- Infection of soft tissues

- Oro-antral fistula
- Failure of the socket to heal
- Nerve damage
- Osteomyelitis
- Osteoradionecrosis.

LOCAL COMPLICATIONS

IMMEDIATE COMPLICATIONS

Failure of Local Anesthesia

Failure of local anesthesia is usually the result of either inaccurate placement of the anesthetic solution, too small a dosage, or not waiting long enough for the anesthesia to act before commencing surgery. Both patient and operator need to know that the anesthetic is working satisfactorily before the extraction can proceed procedure starts. A simple test of adequate numbness is to push a blunt probe firmly into the gingival crevice around the tooth for extraction. Whilst the patient will feel the transmitted pressure from the probe there should be no sensation of sharpness or pain. An additional caution is to tap the tooth with a mirror handle as occasionally there is possibility of periodontitis, and therefore would be painful to extract, is not detected using the probe test. If anesthesia cannot be secured by using conventional techniques of infiltration or regional block, intraligamental, intraradicular or intrapulpal injections may be indicated, provided that the cause of the failure is not local infection around the tooth. Local anesthetic should not be injected to infected tissues because of the risk of spreading the infection.

Failure to Move Tooth

If the tooth does not yield to reasonable displacing forces applied with forceps or elevators, this normally indicates that either the bone texture is dense and inelastic, or that the root shape is obstructing its path of withdrawal. To apply forceps using even greater force is likely to result in fracture of the tooth or exhaustion of both the operator and the patient. The cause of the obstruction should be found out by taking a radiograph before proceeding to lift

a mucoperiosteal flap and remove bone and/or divide the tooth as indicated.

Fracture of Tooth

The causes of crown or root fracture are:

- Excessive force applied to the tooth
- A tooth weakened by caries or large restorations.
- Inappropriate application of force resulting from failure to grasp enough of the root mass or using forceps with blades too wide to make two point contacts on the root
- Haste due to impatience or frustration
- Unfavorable root anatomy.

Tooth fracture is an inconvenience, but need not be a disaster, and it happens to even the most experienced dentists. The key to managing this potential problem is to reassess the situation and decide whether to proceed, or abort the extraction attempt and refer the patient for oral surgical advice. Inspection of the fractured tooth shows the likely size and position of the retained root. If there is no pre-operative radiograph that shows the whole of the root structure then one should be taken at this stage. When only the crown has been removed, it may be possible to reapply root forceps, but this is unlikely to be productive unless there is a reasonable amount of root accessible above alveolar bone level, and the root has already shown signs of loosening. When the root itself has fractured, retrieval of the retained portion normally requires a surgical approach. The operator must assess whether this surgical task is feasible cooperation of the patient, the facilities available and his or her level of experience.

Ideally all roots should be removed but some apical fragments may be difficult or hazardous to pursue because of the proximity of the inferior dental nerve or the antral floor. Such small apices are best left in situ and rarely cause symptoms. In general, a root fragment of a vital tooth, less than 5 mm in length, can normally be safely left in the jaws of healthy patients. Larger root fragments and those with necrotic pulps or periapical radiolucent areas should be removed, unless the risk of

so doing outweighs the potential gain. If it is decided that the root can be safely retained, then the patient must be informed of this eventuality along with a suitable explanation, and both the retention of the root apex and the information given to the patient should be recorded in the clinical notes.

Fracture of Alveolar Bone

Fracture of alveolar bone is a common complication of tooth extraction, and examination of extracted teeth reveals alveolar fragments adhering to a number of tooth. This may be due to the accidental inclusion of alveolar bone within the forceps blades or to the configuration of roots, the shape of the alveolus, or to pathological changes in the bone itself. The extraction of canines is frequently complicated by fracture of the labial plate, especially if the alveolar bone has been weakened by extraction of the lateral incisor-and/or the first premolar prior to the removal of the canine. If these three teeth are to be extracted at one visit, the incidence of fracture of the labial plate will be reduced if the canine is removed first.

It is advisable to remove any alveolar fragment which has lost over one-half of its periosteal attachment, by gripping it with hemostatic forceps and dissecting off the soft tissues with a periosteal elevator.

Fracture of Maxillary Tuberocity

Fracture of maxillary tuberocity occasionally, during the extraction of an upper molar, the supporting bone and maxillary tuberocity is felt to move with the tooth. This accident is usually due to the invasion of the tuberocity by the antrum, which is common when an isolated maxillary molar is present, especially if the tooth is overerupted. Pathological germination between an erupted maxillary second molar and an unerupted maxillary third molar is a rare predisposing cause. When fracture occurs the forceps should be discarded and a large buccal mucoperiosteal flap raised. The fractured tuberocity and the tooth should then be freed from the palatal soft tissues by blunt dissection and lifted from

the wound. The soft-tissue flaps are then approximated with mattress sutures which evert the edges and are left in situ for at least 10 days.

If this complication occurs in one maxilla the patient should be warned that it is liable to complicate a similar extraction performed on the other side of the mouth. Only if a preoperative radiograph reveals the possibility, it is possible to reduce the risk of fracture of the tuberosity by extracting the tooth by careful dissection.

Fracture of an adjacent or opposing tooth during extraction can be avoided. Careful preoperative examination will reveal whether a tooth adjacent to that to be extracted is either carious, heavily restored, or in the line of withdrawal. If the tooth to be extracted is an abutment tooth, the bridge should be divided with a diamond disk before extraction. Caries and loose or overhanging fillings should be removed from an adjacent tooth and a temporary dressing inserted before the extraction. No force should be applied to any adjacent tooth during an extraction, and other teeth should not be used as a fulcrum for an elevator unless they are to be extracted at the same visit.

Opposing teeth may be either chipped or fractured if the tooth being extracted yields suddenly to uncontrolled force and the forceps strike them. Careful controlled extraction technique prevents this accident.

Under general anesthesia, teeth other than the one being extracted may be damaged by the injudicious use of gags and props. The presence of heavily restored or loose teeth, crowns or bridges should be noted and brought to the attention of the anesthetist. Such teeth should be avoided when props or gags are inserted. If possible mouth gags should not be used. Gags and props must either be placed under direct vision, or, if inserted by an anesthetist standing behind the patient, should be guided into place by the operator.

Fracture of the Mandible

Fracture of the mandible may complicate tooth extraction if excessive or incorrectly applied force is used, or

pathological changes have weakened the jaw. Excessive force should never be used to extract teeth.

The mandible may be weakened by senile osteoporosis and atrophy, osteomyelitis, previous therapeutic irradiation, or such osteodystrophies as osteitis deformans, fibrous dysplasia. Unerupted teeth, cysts, hyperparathyroidism, or tumors may also predispose to fracture. In the presence of one of these conditions, extraction should be attempted only after careful clinical and radiographic assessment and the construction of splints preoperatively. The patient should be informed before operation of the possibility of mandibular fracture, and should this complication occur treatment must be instituted at once. If a fracture occurs in the dental surgery, extra-oral support should be applied and the patient referred immediately to a hospital where facilities for treatment exist.

Dislocation of an Adjacent Tooth

Dislocation of an adjacent tooth during extraction is an avoidable accident. Improper application of elevator may lead to this type of complication. During elevation a finger should be placed upon the adjacent tooth to support it and enable any force transmitted to it to be detected.

Dislocation of the Temporomandibular Joint

Dislocation of the temporomandibular joint occurs readily in some patients and a history of recurrent dislocation should never be disregarded. This complication of mandibular extractions can usually be prevented if the lower jaw is supported during extraction. The support given to the jaw by the left hand of the operator should be supplemented by that given by the anesthetist or an assistant pressing upwards with both hands beneath the angles of the mandible.

Dislocation may also be caused by the injudicious use of gags. If dislocation occurs it should be reduced immediately. The operator stands in front of the patient and places his thumbs intra-orally on the external oblique ridges lateral to any mandibular molars which are

present and his fingers extra-orally under the lower border of the mandible. Downward pressure with the thumbs and upward pressure with the fingers reduce the dislocation. If treatment is delayed muscle-spasm may make reduction impossible, except under general anesthesia. The patient should be warned not to open his mouth too widely or to yawn for a few days postoperatively, and an extra-oral support to the joint should be applied and worn until tenderness in the affected joint subsides.

OROANTRAL PENETRATION

The incidence of oroantral communication after tooth extraction is probably high but as the number of patients with residual fistulae is small, the ability of the alveolar tissues to heal spontaneously is marked.

Predisposing causes of oroantral communications are:

1. The relationship of unerupted teeth and of the roots of standing teeth to the maxillary sinus. Submerged premolars or upper first molars at extraction are likely to produce communication with the antral cavity. Tooth shape anomalies which may produce their own physical problems of surgical removal. Excessive deposition of cementum around the roots of the upper premolar and molar teeth often leads to root fracture at the time of extraction. Hypercementosis occurs in relation to lone standing teeth or when teeth have chronic excessive occlusal loads. Generalized hypercementosis may be idiopathic in origin, but that accompanying Paget's disease or even acromegaly may give insight to the underlying generalized bone disease. In advanced disease the increase in root size can be gross and must produce surgical difficulties on extraction. In a patient with previously undiagnosed established Paget's disease the writer has seen excessive extraction force subluxate all the molar teeth in one quadrant together with their grossly hypercementosed roots and supporting alveolar bone. Encroachment of such roots and the altered bone on the maxillary sinus may distort the anatomical cavity but produce no other special features.

2. Where the sinus has extended into the alveolus especially each side of a longstanding molar tooth or posteriorly enlarged tuberosities.
3. Bulbous or curved roots or bony sclerosis leading to excessive force being used for an extraction.
4. Loss of periapical bone due to the presence of a granuloma or an apical periodontal cyst.
5. Dental elevators incorrectly applied either 'blind' or using vertical instead of transalveolar forces.
6. Surgical procedures performed for the removal of lesions such as cysts or neoplasm lying in the maxillary sinus.

Healing of Oroantral Penetrations

An oroantral penetration does not necessarily become a permanent fistula as a small perforation will often heal spontaneously. The main factor favoring healing is an adequate thickness of bone between the sinus and the mouth, ensuring that the socket is of sufficient depth to encourage fibrous repair to take place and so keep antral or oral epithelium separate. Similarly, the smaller the diameter of the bony deficiency the better is healing. Infection in or around the socket, or raised air pressures on one or other side of the wound are detrimental. When these conditions are satisfactory it can be expected that granulation tissue, then callus, will seal the wound and allow it to epithelialize on both the sides.

On occasions the extraction of a maxillary molar will be accompanied by a fragment of the smooth concave antral floor, attached between its roots, which may retain some antral lining confirming the presence of an oroantral communication. A mouthwash or later a drink may come down the nose, a free-flow of air and bubbling between the mouth and nose may be noticed, or difficulty experienced in smoking or blowing against resistance. No attempt to prove the presence of a fistula by probing or other means should be made.

The following measures will assist healing:

Socket Edge Reduction and Simple Suturing

Reflection of the buccal mucosa and reduction of the bony outer wall of the socket with rongeurs to eliminate

part of the buccal root spaces will allow the mucoperiosteum to fall medially. It may then be sutured to the palatal side of the socket with horizontal mattress sutures. This technique does not close the socket opening but reduces it and helps support clot formation.

Use of a Supporting Pack or Protective Dental Palate

Placing any non-resorbable dressing into the socket means that healing must occur by secondary intention. Hemostatic substances such as oxidized cellulose 'Surgical' (Ethicon) or 'Oxycell' (Parke-Davis) are similarly to be avoided if possible. However, where support of the clot is required, a short length of 1.5 cm ribbon gauze is folded and soaked in an antiseptic agent such as Whitehead's varnish or bismuth-iodoform-paraffin paste (BIPP). It is suspended across the socket, and held in place by prepared loops of sutures crossing from the palatal buccal mucosa. All packs should be sutured to the wound edge to prevent their loss. They are kept in position for 2 weeks and then removed.

A protective dental plate worn for a limited period may partly prevent food particles being forced into the socket. When taking impressions for the appliance, the socket must be adequately protected by a layer of gauze to prevent impression material being forced into the sinus. These supportive measures are no substitute for a good surgical technique but may be sufficient to prevent a permanent communication.

Nose Blowing and Mouth Washing

Restriction of nose-blowing to avoid raising the air pressure in the antrum and of mouth-washing to protect the clot is advised until healing is complete. A suitable prophylactic antibiotic cover will help to prevent infection.

TREATMENT OF THE ESTABLISHED OROANTRAL FISTULA

Exposure of the antral cavity to the mouth for any length of time will expose the sinus to salivary secretions and contamination with food debris. This will induce chronic irritative changes in its lining and hence infection, which

will disturb the normal ciliary action and mucous flow which transfers foreign bodies to the medial antral wall. Early closure of such a communication is vital, but there are contraindications to immediate surgery.

The first is the degree of soft tissue damage that has accompanied the extraction. Macerated and edematous oral tissue prevents early closure and a decision to leave the fistula for 3 or 4 weeks may have to be taken, whereas with minimal trauma to the mucoperiosteum closure can be performed in the first 48 hours.

The second is infection of the antrum. The success of all surgical attempts to close an oroantral fistula depends largely on having a clean sinus with a healthy mucosa. Wherever there is a history of a previous chronic sinus infection, the antrum must be radiographed to assess the state of the lining, including chronic mucosal thickening or cavity obliteration. Where there is a history of longstanding disease with chronic mucopurulent nasal discharge, closure of the fistula must be combined with an intranasal antrostomy to provide drainage in the postoperative period.

Where the sinusitis is related to the creation of the defect and is of shorter duration it may be treated conservatively, unless widespread polypoidal changes in the mucosa make it unlikely that it can be improved by simple measures. Indeed polyps may make irrigation impossible or uncomfortable.

Fistulae that have been open for weeks will frequently show a localized hyperplastic polypoidal change immediately surrounding the defect, and metaplastic change to squamous epithelium may have occurred. This can be treated by local removal of the affected sinus mucosa at the time of attempted surgical closure.

Conservative treatment consists of daily antral lavage through the socket, enlarged if necessary to give sufficient access to allow the patient to perform the irrigation with warm saline using a bulb syringe. Over 4-6 weeks the infection should resolve and the communication may even have closed spontaneously. After this time epithelialization of the tract will have occurred. Any attempt at permanent closure must be delayed until the infection is settled.

Buccal Mucoperiosteal Flap

This surgical approach was first described by Von Rehrmann (1936).

Most patients will prefer the surgery to be completed under general anesthesia, though it can be performed satisfactorily under local anesthesia. Nasotracheal intubation through the nostril of the opposite side gives an unimpeded intraoral approach and permits a nasal antrostomy to be performed where necessary. Alternatively, an oral tube taped to the opposite angle of the mouth is acceptable. Hemostasis and visibility are much improved by the use of a local vasoconstrictor subject to agreement with the anesthetist. This is introduced along the anterolateral wall of the sinus and behind the zygomatic buttress, being infiltrated freely to separate fascial planes. A further reduction in bleeding can be produced by tipping the table to raise the head.

As in all procedures for closure of an established fistula, the excision of the partially or wholly epithelialized fistulous tract is imperative. An incision is made with a no. 11 blade. 2 mm outside and encircling the fistulous tract. This should pass either down to underlying bone or through the bony defect and into the sinus cavity. The excised tubular tract is then grasped with fine curved artery forceps and removed, and as a precautionary measure sent for histopathological examination. This procedure must lay bare bone and connective tissue to which the advanced cheek mucosa and periosteum can unite. It is vital that where necessary further mucosa is removed palatally to expose about 3 mm of the bony edge so that the line of repair will be supported on bone.

From the anterior and the posterior limit of the excised fistula two divergent buccal incisions pass up into the vestibule. They are made with the scalpel blade pressed hard on to bone, to cut through mucosa, connective tissue and periosteum to a level well above the attached gingiva. The funnel shape allows the flap to be advanced palatally between the standing teeth.

The posterior limb is the shorter of the two, and can be quite short when placed further back in the buccal sulcus, particularly in elderly patients who have alveolar

resorption. A longer posterior limb will not only make control of hemorrhage more difficult by involving the branches of the maxillary artery as they pass forward on the outside of the lateral antral wall, but the scalpel will leave the bone surface, and therefore the periosteum, as it passes into the soft tissues above. Where it is not possible to make the divergent limbs of equal length, sufficient laxity is obtained by extending the anterior incision in a curve forward and upward over the apices of the teeth. The mucoperiosteal pedicle flap may then be advanced down and back to meet the palatal mucosa.

A coronal view of the maxilla and the oral soft tissue shows that the mucosal and periosteal layers separate at the vestibular fornix so that the mucosa descends to the cheek while the periosteum continues upwards, following the anterolateral and buccal aspects of the maxillary bone above. The flap cannot be advanced in a palatal direction without sectioning the rigid fibrous periosteum and so freeing the more elastic mucosa and submucosal connective tissues to be drawn across the ridge. To do this the incisions must extend beyond the vestibular height to allow the flap to be everted and so expose the periosteum beyond the reflection of the mucosa. A horizontal cut through the periosteal layer alone, made in one stroke high up and adjacent to the maxilla enables the flap to be advanced easily mainly from its anterior edge over the crest of the alveolar ridge to a point well palatal to the fistula. Its final position it must lie without tension with the suture line resting on bone. Sufficient laxity may be provided by digital stretching after it has been undercut.

The leading alveolar edges of the buccal flap are trimmed to fit accurately into the area already provided by excision of the fistula. The advanced pedicle must also closely contact the adjacent teeth as it passes across the arch. The edge of the palatal mucosa may be slightly elevated to allow eversion of the raw edges of the wound with horizontal mattress sutures. To complete the procedure the entire incision is repaired with interrupted sutures and the buccal vertical limbs of the incision are also loosely closed. All sutures are, unless resorbable,

removed after 10 days. As there is a hematoma within the sinus cavity over the mucoperiosteum that has been advanced, every effort should be made to prevent infection. This is done by prescribing the antral regime.

A disadvantage of this repair is the local reduction in sulcus depth caused by drawing the cheek across the sulcus. It is most marked in the first week following surgery. Some 40% of oroantral communications closed using this method still had sulcus reduction at about 6-8 weeks, but had minimized at 6 months.

Palatal Mucoperiosteal Flap

When the oro antral fistula is related to the palatal side of the ridge or where buccal procedures have failed usually because of considerable ridge resorption, a palatal pedicle flap based on the greater palatine artery may be lifted and rotated across the arch perhaps to be attached to the buccal tissues.

The palatal mucosa is firmly fused to periosteum from which separation is difficult. This makes the palatal flap thick and inelastic so that it must be made longer than would appear necessary. Even so, only limited rotation can be safely performed without twisting the palatine artery and thus devitalizing the flap. Rotation posterior to the second molar is not recommended though it may be used for closing an oro antral or oronasal communication on the contralateral side of the mouth in this position. The fistula is dissected out and the mucosa cut back to expose 4 mm of bone all round the defect. The palatal margin of the excised fistula is made to coincide with the lateral edge of the palatal flap. An incision is made along the mid palatal line from just anterior to the junction of hard and soft palate and curved laterally toward the affected side, when it has reached the canine and lateral incisor region. It then passes back about 4 mm palatal to the crest of the edentulous ridge or the gingival margin of the fistula when excised.

The flap is lifted and detached from the palate anteroposteriorly until it can be rotated laterally to lie without tension over the fistula. This maneuver can be helped by removing a small notch buccally. After it has

been trimmed to fit the defect accurately it is sutured to the recipient area with horizontal mattress sutures and interrupted sutures secure the line of closure supported on bone.

The denuded bone anteriorly is then covered by ribbon gauze soaked in an antiseptic solution. The sutures are retained for 10 days and the pack for 3 weeks. The uneven palatal surface regains a very nearly normal appearance in about 2 months.

The Palatal Island Flap

This plastic procedure dissects out an island of palatal mucosa but retains its connection to the greater palatine artery (Brosch 1950). Variations of this technique have been described by Millard (1962) and Moore and Chong (1967). By dissecting the greater palatine neurovascular bundle back to the palatal foramen, some extension can be provided and the flap can be transferred as a well-nourished full thickness flap to a palatal or buccal site. Twisting of the exposed artery is reduced by virtue of its length but care with manipulation of the vascular supply is imperative.

Bridge Flap

Other forms of local flap have been used but offer no greater degree of certainty or ease of procedure than those already discussed. In the edentulous maxilla a local bridge of tissue in an area adjacent to a fistula may be mobilized and moved back to cover it (Kazanjian 1949; Schuchardt 1953). After excision of the fistulous tract incisions are placed transversely across the line of the arch. The length of the bridge of mucoperiosteum is somewhat limited at its palatal end by the palatine artery which may not be preserved. It can however be extended buccally sufficiently to elevate and lift it over the fistula without tension. It is then sutured to the undisturbed edge of the mucoperiosteum on the distal edge of the defect. The bridge must be wider than the bony defect and broad enough for its margins to be well seated on bone. It follows therefore that the size of the fistula must be accurately measured before the incisions for the bridge

are made. The denuded bone of the donor area will granulate under a pack and later epithelialize.

Gold Foil Technique

It is an attractive conservative measure because it requires the minimal surgical intervention, can be completed easily under local anesthesia, and preserves the full depth of the sulcus. It is advocated primarily for the management of very large fistula or those repaired by one of the other techniques described which have failed subsequently, and where an immediate, simple, trouble-free protection for the sinus is required. As for all other methods it can only be used when the maxillary sinus is free of infection.

The fistulous tract is excised, or curetted to take away the epithelial lining and bring the underlying defect into view when any diseased bone is removed. A linear incision along the crest of the ridge is extended 1.5 cm anterior and; posterior to the defect and the oral mucoperiosteum reflected from around the area for about 5 mm surrounding the defect. A small oblong piece of gold foil (24 ct) 35 gauges is placed on the bone to cover the hole completely, with an overlap of 3 millimeters that can be tucked under the edges of the mucosal wound to prevent displacement. The incision is then closed with interrupted sutures, no attempt being made to oppose the tissues but leaving an elliptical defect which exposes the underside of the gold throughout the healing period. Granulation tissue grows from the wound edges on the superior antral surface of the inert gold foil and crosses it to form a bridge. This is said to be complete in most patients in 3-6 months.

The sutures are removed after 10 days. As healing progresses the edges of the oral wound recede progressively to expose the gold foil which in time can be removed with little difficulty. The oral surface then gradually epithelializes. The obvious problems are that healing above the foil cannot be seen and that conventional repair by one of the other methods may be needed later.

SUPPORTIVE MEASURES

The postoperative regime will depend on the state of the antrum found at the surgery and the nature of the procedure. In general the patient should be advised to follow the antral regime for the first 10 days after operation.

DISPLACEMENT OF THE TOOTH OR A ROOT INTO THE TISSUES

This is a rare but potentially serious complication. The tooth or part of it may be lost under a mucoperiosteal flap into the lingual pouch through the thin lingual cortex of bone in the lower third molar region, or into the infratemporal fossa around the back of the maxillary tuberosity from the upper molar region. Improper application of forceps to a tooth or elevating a root with inadequate access may cause such displacement. Any root or part of the tooth that is unaccounted for during extraction should be pursued by taking a further radiograph of the socket and, if possible, the surrounding area. The patient should then be referred for further investigation and management by an oral surgeon.

If a tooth or root is lost from view during the course of an extraction, it may be in one of the following sites:

- Swallowed into the stomach or inhaled into the lung. If either of these is suspected the patient should be sent to hospital for abdominal and chest radiographs.
- Pushed into the antrum.
- Displaced into a soft tissue space.
- Collected inadvertently by the suction apparatus.
- Still in the socket.

COLLATERAL DAMAGE TO SURROUNDING SOFT TISSUES

A certain amount of disruption to the gingival tissues around an extracted tooth is to be expected. Some attached gingiva may need to be dissected free of small fragments of alveolar bone but such displaced tissues, like flaps of mucoperiosteum can be replaced with sutures. However, the incidence of the following modes of soft tissue injury can be reduced with care and forethought:

Exodontia Practice

- Gingival tissue lacerated by the forceps blades. Be sure to place the blades inside the gingival crevice and not trap the soft tissue against the tooth. This is a particular danger on the lingual aspect of lower teeth.
- Lower lip crushed against the lower teeth while extracting resistant upper molars. This is due to incorrect angulations of the forceps and is more likely to happen under general anesthesia or when the patient's lower lip is also anesthetized. Awareness of this problem is usually enough to prevent it.
- An elevator that slips off the intended point of application and stabs the tongue, floor of mouth or the palate. Elevators should always be held with the index finger down the shank of the handle towards the tip to act as a 'stop' in case the instrument slips.

HEMORRHAGE

Tooth extraction is a stringent test of hemostasis and excessive bleeding from the socket occurs not infrequently even in patients who have no pathological hemorrhagic tendency. The bleeding may be at the time of surgery— primary hemorrhage within a few hours after surgery when the vasoconstriction of damaged blood vessels ceases—reactionary hemorrhage, or present up to 14 days post-operatively as a result of infection—secondary hemorrhage.

All patients should be asked whether they or any blood relative have a history of excessive bleeding and full details obtained about relevant previous incidents particularly following tooth extraction. If a hemorrhagic diathesis is suspected then the patient should be referred for investigation by a hematologist. Diseases causing excessive bleeding may involve abnormalities of:

- Blood clotting, e.g. hemophilia, or more commonly the acquired complication of anticoagulant therapy.
- Platelet deficiency (thrombocytopenia). Either because to rapid destruction or failure of production of platelet.
- Blood vessels.

Precautions to minimize the risk of hemorrhage include careful handling of the tissues to avoid

unnecessary trauma. Placing a gauze pack over the socket for at least 10 minutes with the patient applying steady pressure by biting gently to encourage a blood clot to form in the socket, and then instructing the patient not to disturb the clot by avoiding vigorous mouth rinsing or chewing.

If hemorrhage becomes a problem at the time of extraction it is essential to have good suction apparatus available so that clear vision of the operative field is possible. Injecting further local anesthetic solution containing a vasoconstrictor can help substantially to control soft tissue bleeding whilst a horizontal mattress suture is placed across the margins of the socket. A small oxidized cellulose gauze (Surgicel-Ethicon) placed into the superficial part of the socket further stabilizes the forming blood clot at this site. When persistent oozing is coming from the cancellous bone, this can be stopped by smearing bone wax into the relevant spaces in the bone marrow. If all else fails then packing the socket with gauze soaked in Whitehead's varnish (compound iodoform paint) is a reliable solution to the problem but the pack must be removed 10 days later.

When patients return with post-operative hemorrhage it is often amidst a flurry of high anxiety and blood stained dribbling. Sitting the patient down quietly, cleaning away the blood clots that have formed in the mouth but evidently not in the socket, and giving reassurance while the patient bites on a pack placed accurately over the bleeding area will do much to tackle the situation. In some cases this may be enough to stop the hemorrhage. Normally it is helpful to inject local anesthetic around the socket and then suture its margins with or without the placement of a pack. The medical history should be checked along with any drugs that are being taken, notably any anticoagulant such as warfarin, although aspirin and non-steroidal anti-inflammatory drugs have an anti-platelet action and may sometimes be the cause of significant hemorrhage. If it is thought that there could be a systemic rather than a local reason for the bleeding, it may be appropriate to refer the patient for further investigation. In the case

of hemorrhage that is not controllable by the above measures, the patient should be sent directly to hospital for surgical management which in severe cases requires blood transfusion.

Most patients who return complaining of post-operative hemorrhage is accompanied by anxious relatives or friends and it is essential to separate the patient from these well-intentioned, but unhelpful, companions. Until the patient has been taken to the dental surgery and the persons accompanying him asked to remain in the waiting room, it will be quite impossible either to reassure or treat him satisfactorily. After seating the patient comfortably in the dental chair and covering his clothes with a protective waterproof apron, the dental surgeon should examine the mouth in order to determine the site and amount of hemorrhage. Almost invariably an excess of blood-clot will be seen in the bleeding area and this should be grasped in a piece of gauze and removed. A firm gauze pack should then be placed upon the socket and the patient instructed to bite upon it. If tannic acid powder is placed upon the portion of the pack adjacent to the bleeding socket it will help to arrest the hemorrhage. In most instances it will be advisable to insert a suture into the mucoperiosteum, under local anesthesia, to control the hemorrhage. An interrupted horizontal mattress suture is best suited to this purpose and should be inserted across the socket as soon as possible. The object of suturing is not to close the socket by approximating the soft tissues over it, but to tense the mucoperiosteum over the underlying bone so that it becomes ischemic. In the vast majority of cases, the bleeding arises not in the bony socket but from the soft tissues surrounding it and is stopped by the procedure described above. The patient should be instructed to bite upon a gauze pack for 5 minutes following the insertion of a suture. Should these measures fail to control the hemorrhage, either gelatin or fibrin foam may be tucked into the socket. After the pack has been placed in situ and an extra-oral support provided, the patient should be referred to the nearest hospital for further treatment. The mouth tastes unpleasant after a dental hemorrhage,

but repeated rinsing promotes bleeding and should be avoided. The oral cavity should be cleaned carefully with gauze soaked in cold water, special attention being paid to the tongue. This simple procedure adds greatly to the patient's comfort.

DRY SOCKET

Dry socket has "plagued oral surgeons since the practice of exodontia began". It is one of the most perplexing post extraction complications.

The term 'Dry socket' was first introduced by Crawford in the year 1896. Other terms describing the condition include alveolitis sicca dolorosa, fibrinolytic osteomyelitis, alveolalgia, osteomyelitis syndrome.

Dry socket is a term generally understood to refer to the delayed onset of severe pain associated with breakdown of clot. This has been satisfactorily established in a normal extraction wound.

Etiopathogenesis

It is the subject of debate with the opinions being divided into two main schools of thought.

The first opinion, i.e. inability to form the clot based on the presumption that there is an absolute absence of blood clot or improper blood clot formation.

Second opinion i.e. dislodgement of clot, assumes initial formation of blood clot which however, is subsequently lysed and lost, leaving behind the empty socket. The loss of blood clot from the extraction socket is probably the most accepted factor because of various reasons which lead to dry socket.

In most of the cases the clot is lost from the socket due to patient's carelessness in following postoperative instructions particularly vigorous and constant mouth rinsing, constant drink which have bubbling effect destroys the clot or weaken the adherence of clot to the socket wall, making it more vulnerable for dislodgement.

Breakdown of the clot due to fibrinolytic mechanism should be given due consideration. According to Brin's hypothesis, the fibrin is lysed by plasmin which is an

enzyme, acting at neutral pH. A proenzyme plasminogen is converted to plasmin by the action of activators or kinases like bradykinin and kininogens, released from traumatized mucosa, periosteum, bone marrow, and concentrate in the endothelial cells of blood vessel. Its release is promoted by variety of stimuli. It may also come from body fluid or arises in plasma precursors which are proactivators. Thus this plasmin breaks down the fibrin network of clot, making the socket dry.

The recent study has shown that the oral anaerobic bacteria '*Treponema denticola*' which is a normal habitant of oral cavity has fibrinolytic activity. The enzymes produced by this microorganism have a plasmin like activity leading to breakdown of clot and dry socket even in the absence of mentioned fibrinolytic mechanism. This organism doesn't produce pus, swelling or redness, since it is an anaerobic infection. It explains the foetid odor and bad taste associated with dry socket.

The degree of fibrinolytic activity of common oral bacteria such as streptococcus hemolytics, staphylococcus, and bacteroides is probably not sufficient to be the cause of dry socket.

PREDISPOSING FACTORS

Difficulty during Extraction

If more force is used than average to extract the tooth, it may damage and devitalize the bone of socket wall, reducing its resistance to infection from *Treponema denticola* like organism and increasing the local release of plasminogen activators.

Site of Extraction

Mandibular extractions are complicated by dry socket more frequently than maxillary extractions. The mandible has much dense bone and is less vascular as compare to maxilla.

Also lower teeth are more difficult to extract and gravity ensures the mandibular sockets to become contaminated with food debris.

Sclerotic Jaw Bones

In sclerotic jaw bones and irradiated jaws blood supply is reduced leading to improper clot formation which is vulnerable to lysis leading to dry socket.

Vasoconstrictors

Reduced vascularity due to the action of vasoconstrictors inhibits the vascular component of the inflammatory reaction and tends to favor the establishment of infection.

Patient on Oral Contraceptives

The use of oral contraceptives has a significant role in increasing the probability of dry socket after tooth extraction. Increased fibrinolytic activity is suspected as a causative mechanism.

Diagnosis: The diagnosis of dry socket can be confirmed by gently passing a small probe in the extracted wound, a bare bone is felt which is extremely sensitive.

Signs and symptoms: Following signs and symptoms helps for the correct diagnosis of dry socket.

PAIN

After two to five days patient comes with the complaint of severe pain which is closely localized to the socket, it may radiate to the ear of the same side or other parts of the face, but with or without signs and symptoms of infection such as fever, swelling and erythema. Pain is exaggerated by contact with food during mastication and also by air blow or fluids. The pain becomes dull after some days due to necrosis of tissue in the socket, which covers the bare bone.

HALITOSIS

The food debris may have accumulated in the socket which, with the disintegrating clot, produces a foul taste and smell. Anaerobic micro-organisms *Treponema denticola* could be a etiologic agent that produce foetid odor.

GINGIVAL MARGIN

It is usually swollen and becomes dusky red. The socket itself is either devoid of clot or contains a brown, friable, foamy clot which is easily washed out.

After a period of 7 to 14 days granulation tissue lines the socket and gradually fills it up, often there is no frank sequestrum of the bone but from time to time exuberant granulation forms and small pieces of socket wall or part of the interradicular space separate and are discharged with the formation of small amount of pus, due to superimposition.

Treatment

The treatment of dry socket is directed primarily towards the relief of pain as well as healing of wound and is divided into following ways:

Local Therapy

When patient reports within first 48 hours after extraction, the dry socket should be treated as simple extraction wound in which the necrotic blood clot is removed gently and after irrigation, fresh bleeding is induced under local anesthesia and pressure pack is given with antibiotic cover.

When patient reports after 48 hours, all necrotic debris should be removed and the socket irrigated with a warm sterile isotonic saline solution and diluted solution of antiseptic like Betadine. After irrigation of wound the socket is gently packed with ribbon gauze painted with zinc oxide eugenol paste (with minimum eugenol contents). The ribbon should not be packed forcefully or tightly to form and cover the base of bone. The pack should completely obliterate and isolate the socket from the oral cavity. Dressing can be changed depending upon the severity of the pain but generally the second dressing is not required, as initial healing takes place to cover the raw bone.

Zinc oxide- eugenol dressing protects the bare bone from irritants like food, saliva etc. and prevents food debris from accumulating in the socket. Eugenol being an obtundent relieves the pain by destroying superficial

nerve ending. It also acts as a mild irritant which stimulates the healing and doesn't cause bone necrosis. Bone necrosis chances are more if eugenol is more. ZnO itself works as an antiseptic agent.

Systemic Therapy

Systemic therapy consists of use of systemic antibiotics and antianaerobic agent like metronidazole for rapid recovery with local wound care. Analgesics and anti-inflammatory drugs should be given for relief of pain and to minimize the inflammatory response.

CONCLUSION

Thus it should be noted that dry socket can be taken care like local wound care with a suitable material like ZnO—eugenol dressing. The role of systemic antibiotics is very limited or only to the extent of preventing the superinfection. It should never be considered curative and the patient should not be put on heavy antibiotic or multiple drugs which are not required.

NERVE DAMAGE

The following branches of the nerve may be at risk during tooth extraction. The mental nerve can be damaged by over-extension of releasing incisions in the depth of the buccal sulcus in the lower premolar region, or by bone removal encroaching on the mental foramen just below and between the premolar apices. The affected area of sensory loss extends over the ipsilateral lower lip and chin.

If the tooth or root is in an intimate relationship with the inferior dental nerve, damage can be prevented or minimized only by preoperative radio-graphic diagnosis and careful dissection. The mental nerve may be damaged either during the removal of lower premolar roots or by acute inflammation in the tissues around it. If the nerve is protected by a metal retractor during operation, and bone removal is maximal mesially to a first premolar root and distally to a second premolar root, impairment of labial sensation will be avoided altogether or be minimal and transient.

The lingual nerve may be damaged either by a traumatic extraction of a lower molar in which the lingual soft tissues are trapped in the forceps, or by being caught up with the bur during the removal of bone. A metal retractor should be used to protect adjacent soft tissues from harm whenever a bur is in use.

EXCESSIVE PAIN, SWELLING AND TRISMUS

Some degrees of swelling and discomfort is to be expected after any surgical procedure: tooth extraction is no exception. Suitable analgesic medication prescribed for the patient before the expected onset of pain, combined with appropriate post-operative instructions and reassurance, is normally adequate management of these symptoms. Careful instrumentation and handling of the tissues during surgery minimizes post-operative edema by avoiding unnecessary trauma, but other causes of swelling, such as hematoma formation or infection, cannot always be prevented.

TRISMUS

Trismus is an inability to open the mouth to a normal and is commonly seen following extractions, particularly lower molars. Inflammation and edema may spread from this region to affect the powerful jaw closing muscles, masseter and medial pterygoid, which are then painful when stretched. Severe and progressive trismus occasionally follows a few days after an inferior dental nerve block as the result of the development of a hematoma in the medial pterygoid muscle. The passage of the local anesthetic needle through this muscle may unavoidably pierce a small blood vessel and cause some bleeding between the muscle fibres. Fibrosis of the hematoma may result in prolonged limitation of mouth opening unless active stretching exercises are employed. Trismus due to edema normally resolves spontaneously with the inflammation but the patient can be made more comfortable meanwhile by the application of heat to the affected area.

One of the common complications of an inferior alveolar block is post injection trismus. This may be

caused by (1) needle track infection, (2) trauma to the medial pterygoid muscle, or (3) the development of myofascial pain dysfunction syndrome.

Occasionally there will be a persistent trismus which has certain characteristics that differentiate it from the three conditions referred to above. This condition is not frequently mentioned in the literature, and to suggest that a conservative approach to therapy may be as effective as the more radical procedures that have been advocated by some clinicians.

Campbell, in describing his personal experience with the condition, expressed his opinion that forced opening was unnecessary and harmful and that even stretching exercises should not be used, as spontaneous remission would occur after several months.

Brown believed that such delay in treatment was usually not acceptable to patients and that gentle stretching exercises supplemented by a forced opening under an anesthetic in some cases was the treatment of choice.

Berry quoted some unpublished studies in these patients which led him to believe that the trismus might be a form of guarding of a damaged structure. Therefore, he did not advocate forced opening.

The use of reassurance together with jaw-opening exercises and physiotherapy, in the form of ultrasound, as an initial measure in all cases. Complete failure to respond after a period of 3 or 4 weeks from the commencement of treatment would appear to indicate that forcible opening might be necessary, but this should be undertaken only if the patient is unable to persist with the more conservative method of therapy.

Etiology

Various views exist as to the cause of this condition. Campbell believed that the problem was due to a hematoma in the medial pterygoid muscle. As mentioned earlier, Berry thought that the condition was a form of "guarding" of a damaged structure. It is true that this type of phenomenon may occur in the muscles of mastication. The argument against this is the fact that the trismus does not disappear even if the patient is paralyzed

under general anesthesia. This condition is the result of a needle piercing a small artery with resultant hematoma formation, followed by its organization into a band of tissue in the vicinity the medial pterygoid, is the most feasible one.

(1) onset of the condition is usually a few days following the injection (average time, 3 days); (2) once the trismus begins, it becomes established in about 24 hours; (3) spontaneous pain is unusual, but forced opening of the jaw causes discomfort; (4) there appears to be a "mechanical restriction" of opening. (5) in most with correct conservative management, the condition will resolve in less than 4 months.

The application of intra-oral heat by means of short-wave diathermy or the use of hot saline mouth-baths gives relief in mild cases, but other patients require the administration of antibiotics or specialist treatment to relieve their symptoms.

OSTEOMYELITIS

Osteomyelitis is an established infection within bone tissue. All tooth sockets are bony wounds open to the contaminated environment of the mouth, it is surprising that infections of the jaws are not seen more often following tooth extraction. The excellent blood supply of the facial bones as well as the immunological and anti-bacterial activity of saliva is largely responsible for this effect.

Intense penetrating bone pain, prolonged healing of the socket, anesthesia of the lower lip and general malaise are the symptoms of osteomyelitis which, in the acute phase, may show signs of spreading infection and fever. If the infection becomes chronic the main features are suppuration, an indurated swelling, and patchy radiolucency seen on radiographs of the affected bone. Treatment of acute osteomyelitis requires a high dose of an appropriate antibiotic for an extended period, normally several weeks. In addition to this, chronic suppurative osteomyelitis demands surgical debridement of the affected area to remove any sequestra of dead bone.

OSTEORADIONECROSIS

Osteoradionecrosis is an extremely serious complication of radiotherapy to the jaws that can be triggered by tooth extraction. The effect of radiation on the tissues, especially bone, is to reduce dramatically their blood supply, and therefore to increase vulnerability to infection and failure of normal healing. All teeth in the anticipated radiation field that may require extraction should ideally be removed before the patient has radiotherapy treatment or within a few weeks of it (the ischemic post-irradiation effects on bone are slowly progressive over a period of months). If the opportunity for this preradiation management has been missed and a patient who has had radiotherapy needs a dental extraction in an affected part of the jaws, then this should be undertaken in hospital by an oral surgeon.

TRAUMATIC ARTHRITIS OF THE TEMPOROMANDIBULAR JOINT

Traumatic arthritis of the temporomandibular joint may complicate difficult extractions if the lower jaw is not supported. The risk of this unpleasant condition occurring can be minimized if the operator uses his left hand correctly and the anesthetist or an assistant steadies the mandible by holding it under the angles. If it is known that the patient has a history of a previous dislocation of the temporomandibular joint it is a wise precaution to get him to hold a dental prop tightly between his teeth on the contralateral side during a dental extraction.

SWELLING

If the soft tissues are not handled carefully during an extraction traumatic edema may delay healing. The use of blunt instruments, the excessive retraction of badly designed flaps, or a bur becoming entangled in the soft tissues predispose to this condition. If sutures are tied too tightly postoperative swelling due to edema or hematoma formation may cause sloughing of the soft tissues and breakdown of the suture line. Usually both conditions regress if the patient uses hot saline mouth-baths frequently for 2 or 3 days.

A more serious cause of postoperative swelling is infection of the wound. No effort should be spared to prevent the introduction of pathogenic microorganisms into the wound. If the infection is mild it will often respond to the application of heat intra-orally by the use of frequent hot saline mouth-baths. The patient should be cautioned against applying heat extra-orally because this increases the size of the facial swelling. A hot-water bottle applied to the cheek in an effort to relieve pain is a common cause of gross swelling of the face. If fluctuation is present the pus should be evacuated before beginning antibiotic therapy. Any patient with a postoperative infection severe enough to warrant antibiotic therapy is best treated at a hospital with oral surgery facilities, especially if the swelling involves the submandibular and sublingual tissues.

Collapse in the dental chair may occur suddenly and may or may not be accompanied by loss of consciousness. In most instances these episodes are syncopal attacks or 'faints' and spontaneous recovery is usual. The patient often complains of feeling dizzy, weak, and nauseated, and the skin is seen to be pale, cold, and sweating. First-aid treatment should be instituted at once and at no time should such a patient be left unattended. The head should be lowered by lowering the back of the dental chair. With some designs of chair the use of this method may be considerable delay and in these circumstances the patient's head should be put between his knees after ensuring that his collar has been loosened. Care should be taken to maintain the airway and to ensure that the patient cannot fall out of the chair. No fluids must be given by mouth until the patient is fully conscious.

If recovery does not occur within a few minutes of first-aid measures being instituted, the collapse is probably not of syncopal origin and oxygen should be administered and medical aid summoned. Careful note should be taken of both the type and rate of respirations, and the rate, volume, and character of the pulse. If

circumstances permit, the blood-pressure should be recorded at intervals.

If respiratory arrest occurs the skeletal muscles become flaccid and the pupils are widely dilated. The patient should be laid flat on the floor and his airway should be cleared by the removal of any appliances or foreign bodies and by pulling the mandible upwards and forwards to extend the head fully. The patient's nostrils should be compressed between the operator's finger and thumb, and mouth-to-mouth resuscitation should be performed so that the chest is seen to rise every 3 or 4 seconds. The efficiency of this form of resuscitation is greatly enhanced if a airway is available and can be inserted over the tongue. Whilst he is attempting to remedy respiratory arrest the dental surgeon must check the carotid pulse and apex beat at regular intervals, for cessation of breathing may be quickly followed by cardiac arrest, which is a more serious emergency.

Unless the circulation can be restored and maintained within 3 minutes of cardiac arrest occurring, irreversible brain damage may occur due to cerebral anoxia. The patient exhibits a pallor and greyness, and his skin is covered with a cold sweat. The pulse and apex beat cannot be felt and the heart-sounds cannot be heard. If the patient is a child, the heart will often start beating again if the sternum is tapped sharply. When an adult is being treated the patient should be laid flat on his back on the floor. The dental surgeon places the heel of his left hand on the lower third of the patient's sternum. The operator then places his right hand on the back of the heel of his left hand and presses downwards rhythmically at second intervals, with sufficient force to compress the heart between the sternum and the vertebral column. If an assistant is present she should simultaneously treat the respiratory arrest in the manner described above. When no assistance is available the dental surgeon should perform respiratory and cardiac resuscitation alternately for periods of 20 seconds.

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Exodontia Practice

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